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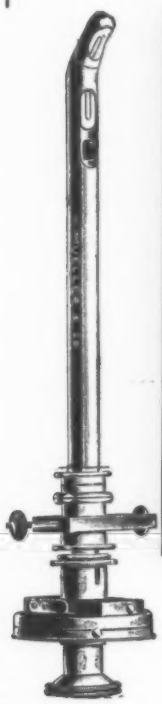

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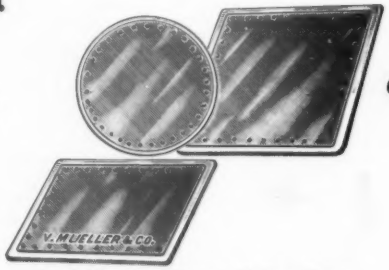

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The Fundamental Physical Action Underlying the Physiological Action of Radium Rays, X-Rays and Ultra-Violet Light

LEONARD B. LOEB, PH. D.
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Chicago, Ills.

ALTHOUGH nearly 20 years have elapsed since the first applications of radium or x-rays to the treatment of disease, and although much clinical data has been gathered, little is known of their physiological chemical action. The study of these radiations from the physical side has fortunately yielded us very precise notions as to the mechanism of the action of these radiations on the atoms of matter. It will then be of some interest to consider briefly the common action produced by all the different radiations on the atoms of matter and to draw from them some conclusions which may be of use to the practitioner.

The one and only effect which these radiations produce on atoms of matter which can concern us is *ionization*. It will be my task this evening to try to prove to you that it is only through the ionization produced by these radiations in human tissues that the chemical and physiological changes are produced. This notion once established, it follows that the effects produced by the radiations must depend on the total number of ions formed per unit volume in the regions treated. Now from our physical knowledge of the radiations we can estimate quite easily what the number of ions formed per unit volume of tissue by a given type of radiation will be, once we define the conditions. This it is obvious will at once lead to a much more accurate and intelligent use of the radiations in the treatment of disease as well as giving us a new *general fundamental* unit for all radiological treatment, viz: the number of ions formed in unit volume of the tissues treated.

Before going further it might be well to point out that in considering the question of a unit of dosage based on physical activity one must overlook the complications introduced by susceptibility.

It is well known to all of you that precisely the same treatment of radiation in the case of different individuals and different tissues produces widely different effects. This phenomenon is encountered wherever drugs are administered. It is eliminated in fixing the dosage by taking the average of the effects produced on a large number of individuals. Thus eliminated it in no way invalidates unit of dosage in the case of drugs. There is, accordingly, no reason why such effects should invalidate the fundamental unit of physical activity of these rays as a unit to be used in the radiological treatment.

In proceeding to the discussion of ionization it will be well first to define what we mean by the term ionization as applied to the action of the rays. We now know that the atoms consist of a massive but minute kernel or nucleus carrying a positive charge, the value of this charge determining the atoms chemical nature. Around the nucleus, possibly much like the planets in our solar system, revolve the small negative electrons, each carrying unit negative charge. As the atom is usually electrically neutral, these electrons must equal in number the value of the positive charge on the nucleus. The molecules which are formed from such atoms consist of the atomic nuclei separated by distances of the order of the diameters of the atoms, and bound together by the electrons which they share in common. A picture of what is possibly much like our nitrogen molecule may be seen in

Fig 1.

Nitrogen Molecule

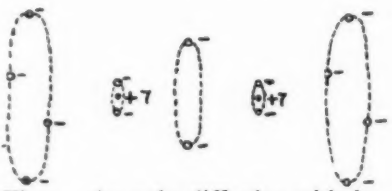


Fig. 1, the only difficulty with it being that the points representing the nucleii and the electrons are much too large relative to the distances which separate the electrons from them. The ratios of these distances are actually something like that of a nucleus the size of a marble in an atom five city blocks in diameter. Such an atom or molecule may, as a result of some sort of a cataclysm, have one of these electrons knocked off. Thus it would have a resultant positive charge and would become a positive ion. The electron would move off through space, eventually attaching to some other neutral molecule, thus making it a negative ion. The positively charged remnant of the molecule, the positive ion, will then remain such until it can pick up an electron lost by some other ionized molecule, or from a negative ion. The union of a positive and a negative ion, particularly if they are from molecules of a different kind, may bring the molecules into con-

tact under such conditions that besides neutralizing their opposite charges they will unite chemically to form new compounds. Thus the act of ionization may result in chemical combination.

Now it is legitimate to ask how it is that the radiations such as alpha rays, beta rays, x-rays, or gamma rays can ionize. We know that the alpha particle is a doubly positively charged Helium atom traveling thru space with a velocity of about 200,000 kilometers per second, while the beta ray is an electron moving with a velocity of 200,000 to 3,000,000 kilometers per second. Since these electrons are negatively charged they must, if they approach closely enough to the electron of a molecule, repel it and therefore send it shooting out of the molecule, thus ionizing it. Alpha particles similarly, when passing near an electron of a molecule will attract it for an instant, giving it a velocity which will send it shooting out of its parent atom. X-rays and ultra violet light act slightly differently. As you see in Fig. 1. there are at the center of the atoms two electrons more closely bound to the nucleus than the majority. Being very rapidly bound, due to the enormous forces close to the positive nucleus, they, when disturbed, vibrate very rapidly, so rapidly in fact that they have frequencies of the order of magnitude of those x-rays. Thus it is these inner electrons in atoms like iron and tungsten that give rise to the x-rays when they are set into vibration. If now these electrons are at rest and x-rays strike them they start to absorb energy from the x-ray pulses. Eventually one of these electrons absorbs so much energy that the forces of the atom can no longer hold it in place.—it then goes shooting out of the atom as a fast *secondary* beta ray. These secondary beta rays act to ionize other molecules as described above. In fact probably 99 per cent or more of the ionization caused by x-rays is caused by the secondary beta particles produced by them. In the case of ultra-violet light, ionization is caused in a manner analogus to that produced by the x-rays except that in this case the electronic groups set into vibration by the light lie on the outside of the atom. That the biological action of ultra-violet light is similar to that of beta rays is shown in the work of Redfield who found that the temperature coefficient of the action produced by beta rays on certain tissues is that characteristic of so-called photochemical reactions. It is likely that the velocity of the electrons emitted by the light is too low to cause as much ionization as do the secondary beta rays liberated by x-rays. Gamma rays from radium act precisely as do the x-rays except that their *secondary* beta rays have velocities comparable with some of the primary beta rays from radium, and also in that having such high frequencies they

less frequently find atoms in a condition to absorb their energy They are therefore much more penetrating.

It may well be asked whether this ionizing action caused by the radiations discussed above is the *only* type of action produced which may account for the chemical changes occurring. It is true that these radiations in some cases produce the emission of light or of secondary x-rays. It is also true that in the case of the absorption of the rays from radium in matter considerable heat is involved. From the physical point of view the light emitted is emitted as a result of the ionization of the molecules. For some few of the molecules, on regaining their electrons, emit light. This light is, however, only capable of producing possible further ionization and its energy in general is so small compared with the total energy expended in ionization, that it can hardly be a factor in producing the effects observed. It might be thought that the local heat produced, i. e., that the high velocity imparted to a molecule due to the impact of a swift alpha particle, might enable the molecules to crash into other molecules with sufficient energy to cause a chemical change. This is a very rare occurrence. For in order to give a molecule an appreciable energy the alpha particle would have to collide with the minute nucleus of one of the atoms or at least pass very close to it. It is obvious that this event must happen very rarely, and in fact observations show it to happen, but once in nearly 100,000 ionizing impacts with molecules. The greater portion of the heat actually liberated by the rays probably comes from the recombination of the ionized molecules. Other than these effects, the radiations in passing through matter produce no effect at all. We are then safe in concluding that the rays act chiefly through the production of ions.

The next question which one may ask is whether the ionization produced is capable of causing the marked chemical changes that underlie the physiological effects of the rays on tissues. The ionization produced in mixtures of hydrogen and oxygen, and hydrogen and nitrogen by alpha particles causes the union of these gases to form water and ammonia. S. C. Lind, Duane, and Wendt, and others claim to have shown that the chemical action produced by the alpha particles in these gases is proportional to the ionization produced by them. We are further aware that the ionization produced in the various electrical gaseous discharges produce ozone in oxygen, and, as Wendt has shown, produced H_3 in hydrogen.

Stieglitz has shown that all chemical reactions of oxidations or reduction in chemistry are *equivalent* to the transfer of one or more electrons from the oxidized to the oxidizing atoms. It

is also well known that the action of x-rays on water result in the formation of H_2O_2, Ozone, H_2, and O_2, and as water is a common constituent of the body, these products alone would cause some action on the tissues. Redfield has shown that the effect of beta and gamma rays on the fertilization membranes of the eggs of a marine worm, Nerius, are in approximate proportion to their relative ionizing efficiency.

How such reactions take place we do not know. The type of ionization which we are considering may conceivably cause such reaction by bringing the oppositely charged ions together, thus giving the atoms chance to rearrange themselves in different or new configurations. It is further possible that the act of ionization may make some delicately balanced molecules unstable so that they lose atoms. These latter, e. g. atomic oxygen, hydrogen or nitrogen, being very reactive, may react in such a fashion as to give new compounds. Recent work of Dempster has indicated that the mere ionization of the hydrogen molecule does not cause it to dissociate into the active atoms. It may well be that in the much more delicately balanced organic compounds such as the proteins and aminoacids, the ionization of one of the atoms of a molecule could cause a complete rearrangement of the molecule. This is a point where a possible study of the chemical changes produced in certain of the delicate organic substances by x-rays might be profitable. We may, however, from the foregoing, conclude that the type of ionization produced by the radiations is perfectly capable of producing the marked chemical changes observed.

We can then safely assume that the amount of chemical change produced in the tissues by the action of these radiations per cubic centimeter of tissue is directly proportional to the total number of ions produced in that cubic centimeter. And we may therefore at once proceed to compare the relative activities of the various types of agents on the basis of their ability to produce ions in a given number at a given place. In doing this I will first show how this number varies with the different factors entering into the exposure.

1. The total number "N" of ions produced per unit volume depends on the number of ions formed per cubic centimeter per second "I" and on the number of seconds exposure t, i. e., $N = I \times t$.*

2. The quality "I" will vary directly with the quantity of radiation emitted by the source per unit time, i. e., "I" is proportional to the quantity Q. In other words the ionization will depend directly on the quantity of radium used, or on the milli-ampereage going through the x-ray tube.

3. The quantity "I" will further depend on the total number of

ions produced per second by the radiations per unit of radiating substance, or radiations, used. Thus we know that the 13.6×10^{10} alpha particles of radium produced 2.56×10^{16} ions per second, per gram of radium when absorbed. The beta particles produce 9×10^{14} ions per second, while the gamma rays from 1 gram of radium produced 13×10^{14} ions. The total number of ions produced by the x-rays from a Coolidge tube operated at about 90,000 volts, with 10 milliamperes possibly yields about 4×10^{17} ions assuming that the efficiency of the x-ray tube is 0.2 per cent in producing x-rays and that each electron in the tube giving a homogeneous x-ray pulse would in matter give 3.5×10^{10} ions. This is an assumption which so far has not been accurately checked experimentally. It is here that some physical work must be done in order to enable one to compare x-ray ionization more rigorously with the radium rays. The value of 3.5×10^{3} was found by Rutherford's pupils for slow beta rays whose velocity is comparable with those of 90,000 volt electrons and checks in order of magnitude with the number of ions to be expected from energy considerations. It is possible that the number of ions estimated above may be in error by a marked amount. This error will make the ionization higher than it really is by a factor which depends on the homogeneity of the rays, and which with the data before me I am unable to estimate.

4. The number of ions per cubic centimeter per second formed in a given region will depend on the fraction of the total radiation from the units of radiation used which strikes the area considered. This fraction is determined directly from the solid angle subtended by the area in question at the source. It can be computed from the ratio of the area cut out of the surface of the sphere surrounding the radiating source at the place considered, by the cone whose apex is the radiating source and whose base is the area radiated, to the total surface of the sphere for the rays from radium, or to the hemisphere for the case of the x-rays. To a sufficiently close degree of approximation it is given by the area A of the region to be treated divided by $4\pi R^2$ for the radium rays, or $2\pi R^2$ for the x-rays, where R is the radius of the sphere, i. e. the distance of the area from the radiating source.

It is at once seen that this states that the intensity of radiation on a given area varies inversely as the square of the distance from the source. This so-called inverse square law of intensity in x-ray treatment has recently been called into question by certain experimenters. Such doubts on the inverse square law are incorrect. The intensity must and does fall off inversely as the square of the distance. The ap-

parent failure of this law to hold in some cases, is due either to improper technique, or to the failure to include in the calculations based on this law the effect of variations due to another factor, namely the secondary radiation effect.

5. Except in the case of alpha particles, if any absorbing material is present such as human tissue, or, in the case of gamma ray treatment, wooden blocks, the ionization proceeds in such a manner that every centimeter of absorbing material cuts down the homogeneous radiations by the same factor. That is, if one millimeter of Al cuts down the ionization produced by x-rays to 0.9 of their initial intensity, the next millimeter of Al will cut down the intensity of the remaining 0.9 to 0.9 of its value, i. e. the intensity due to the two sheets will be 0.81 of the initial intensity. In symbolic form this may be written I is proportional to e^{-md}, where e is the base of the natural system of logarithms, d is the thickness of absorbing material, and m is the co-efficient of absorption of the rays. This varies not only with the different wave lengths of the rays, but also with the nature of the absorbing material. For the beta rays, as they are particles of matter with definite initial velocities, the law holds only *approximately* and only as long as they are not homogeneous. For the case of gamma rays and x-rays, however, the law holds in this form *only as long as the radiations are homogeneous.* For non-homogeneous x-rays the falling off of intensity can be computed by finding the values of m for the different rays present, determining the absorption for each type of radiation present independently and adding the effects. In modern therapy I believe the present movement is an attempt to utilize radiations which are as homogeneous as possible, the softer rays being filtered by aluminum and copper filters.

6. Finally there is a factor in the case of gamma rays and x-rays which has been more or less neglected in calculations up to the present, but which, according to recent work done in Germany by Dessauer, and by Friederich and Krönig, may amount to as much as 300 per cent in extreme cases. This occurs only in the case of treatments below the surface of the body, where the area radiated is relatively large. If the intensity of the ionization be measured on the axis of the cone above described, it will be found to be greater than at the sides. This is due to the fact that the rays falling on the tissue liberate many *soft* x-rays as well as secondary electrons. These are emitted in all directions and quickly absorbed. The result is that the radiation will extend beyond the edges of the cone for a short distance, and that the point on the axis of the cone will receive more of the secondary radiations from the sides than it sends

to the sides. The result will be that the ionization will be greater in the center of the cone. It is the neglect of this factor which has led some to question the validity of the inverse square law. This factor has been determined for x-rays by the writers previously alluded to. It is probable that more work may profitbaly be done in this field to determine these effects with greater accuracy. In studying the various factors we must then add that the intensity at the region studied must be multiplied by the secondary radiation factor F.

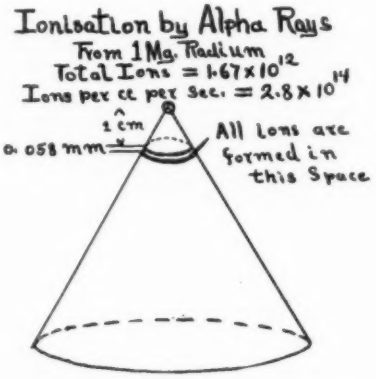
We may now combine all these factors into one equation which states, that the number N of ions formed per cubic centimeter at any distance R under a square centimeter of surface, by Q units of radiation, producing N_0 ions per cubic centimeter when (d = O, R = 1, A = 1, Q = 1, T = 1) acting through a thickness d centimeter of absorbing material whose absorption coefficient is m for the rays considered, for a time T is

$$N = \frac{T\ Q\ N_0\ F\ e^{-md}}{4\pi R^2}$$

This equation holds in general for *inhomogeneous* beta rays and for *homogeneous* x-rays and gamma rays. The constant N_0 must be determined once for all, for any particular source of rays. The equation is dependent on the use of a point source of radiation. The focal spot on the anticathode, and the short emanation tubes used in practice fulfill this requirement to a sufficient degree of approximation. For more than one source the effect may be computed by adding the effects of the various sources.

The alpha particles from radium consist of five different groups, having very definite ranges lying between 3 and 6 centimeters in air. The ionization by these is nearly constant over their range, and they lend themselves easily to computation by the equation above if we omit the e^{-md} factor which is not applicable to particles ionizing uniformly.

Fig 2.


Ionisation by Alpha Rays
From 1 Mg. Radium
Total Ions = 1.67 × 10^12
Ions per cc per sec. = 2.8 × 10^14
1 cm
0.058 mm
All Ions are formed in this Space

On the basis of reasoning of this sort I have roughly computed and arranged graphically, the course of the ionizing action of the alpha, beta, gamma rays of radium, and x-rays, omitting the factor F which depends on data which were inaccessible to me. This is illustrated in Figs. 2, 3,

4, and 5. Fig 2 represents the ionization due to alpha particles from 1 milligram of radium. The total number of ions produced in that portion of the cone generated by the point source of radium and a circular area of 1 square centimeter at 1 centimeter from the radium, below this surface is 1.67 $\times$ 10^{12} ions. These ions are generated nearly uniformly throughout a depth of .058 millimeter below the surface, a very minute distance indeed. The total ionization is about 2.8 $\times$ 10^{14} ions per cubic centimeter for this feeble depth. There is no doubt but that these rays are the most powerful ionizers of all radiations They are, however, obviously impractical for medical treatment.

Fig 3

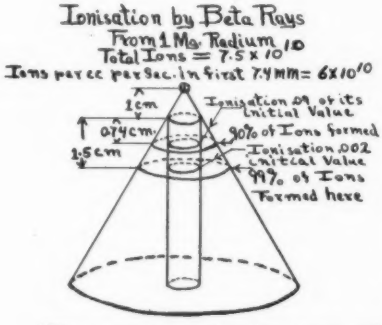
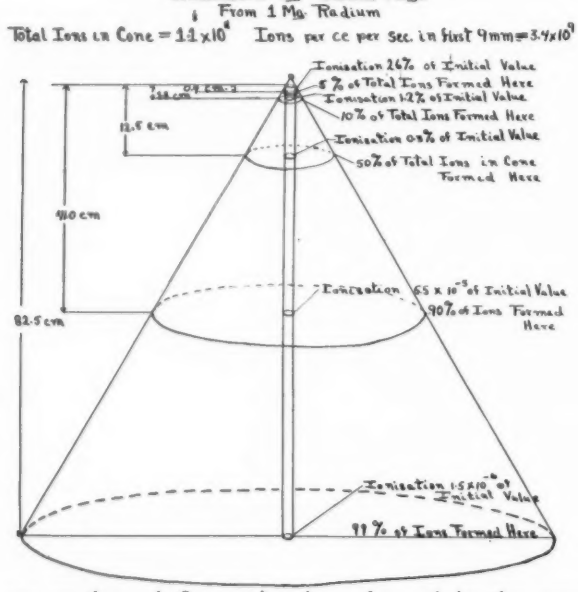

Ionisation by Beta Rays
From 1 Mg. Radium
Total Ions = 7.5 x 10
Ions per cc per Sec. in first 7.4 MM = 6x10
1cm
0.74cm
1.5cm
Ionisation .09 of its Initial Value
90% of Ions formed
Ionisation .002 Initial Value
99% of Ions Formed here

Fig. 3 represents the type of ionization produced by the beta rays from 1 milligram of radium placed 1 centimeter above an area of 1 square centimeter, the ionization taking place practically entirely in the portion of the cone below that region. Besides the cone a cylinder has been drawn on the 1 centimeter square area and prolonged downward. The medium chosen for calculation here is water which it has recently been shown has approximately the same absorbing power as human tissues. On the left are given the depths below the surface cut out by the cylinder, relative to the ionization in the 1 square centimeter at the surface layer. We see that owing to the spreading of the cone the ionization over the cylinder rapidly drops off; this is the effect of the inverse square law of intensity. Further, the number of ions formed, rapidly diminished with depth below the surface of the cone due to the absorption of the rays by the tissue. The total number of ions formed by beta rays in the cone is 7.5 $\times$ 10^{10} ions, a figure about 1/30 of the number of ions formed by the alpha particles. The ionization per cubic centimeter in the first 0.74 centimeters of depth below the surface has an average value of 6.17 $\times$ 10^{10} ions per cubic centimeter, a figure well below that of alpha particles. It is obvious that we have here a useful source of ionization for treating surface conditions where it is inadvisable to treat the portions lying below 1 cubic centimeter depth. In using beta rays the effect of the gamma rays also must be included, but as we shall see these are markedly less.

Figure 4 is a picture of the action of the homogeneous gamma rays from a milligram of radium

studied in much the same way as is the beta radiation, omitting the action of the factor F. This placement of the radium is not very different from that actually used in treatment and it gives us a chance to compare it with the beta rays. We see that owing to the great penetrating power, the gamma rays can go through 82 centimeters before having produced 99 per cent of the ionization they are capable of producing in the cone. At this distance the ionization over the cylinder has been reduced 1/1,000,000 of its value, due to the inverse square law and the absorption. At 12.5 centimeter, 50 per cent of the ions formed in the cone have been formed and the ionization below the area cut out by the cylinder has been reduced to 3/1,000 of its value at the surface. At nine milimeters below the surface the ionization has been reduced to 25 per cent of its value at the surface, while 5 per cent of the total number of ions formed in the cone have been formed at this point. The total number of ions formed in the cone by the gamma rays is about 1.1×10^{11} ions per second. The ionization in the first 9 millimeters of depth is at the rate of 3.4×10^{9} ions per cubic centimeter per second. It is seen that while the total ionization for gamma rays is slightly greater than that due to the beta rays in the whole cone the ions formed in the first cubic centimeter are about 1/20 of the number

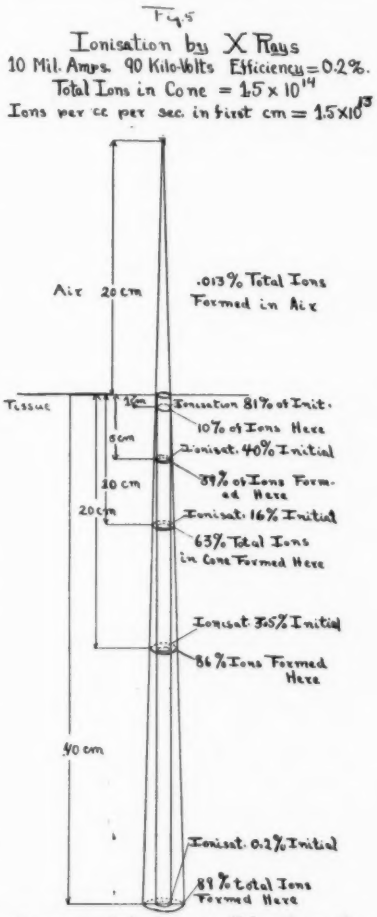
Fig. 4


Ionisation by Gamma Rays
From 1 Mg. Radium
Total Ions in Cone = 1.1 x 10^11
Ions per cc per sec. in first 9mm = 3.4 x 10^9
Ionisation 26% of Initial Value
5% of Total Ions Formed Here
Ionisation 12% of Initial Value
10% of Total Ions Formed Here
Ionisation 03% of Initial Value
50% of Total Ions in Cone Formed Here
12.5 cm
9.0 cm
82.5 cm
Ionisation .65 x 10^-3 of Initial Value
90% of Ions Formed Here
Ionisation 1.5 x 10^-6 of Initial Value
99% of Ions Formed Here

formed by the beta rays. That means in order to produce the same effect at the surface with gamma rays the treatment would have to be 20 times as long as with the beta rays from the same specimen of radium. For treatment below the surface it is obvious that the gamma rays will be far more effective. Though to get the same effect 12.5 centimeter below the surface that one gets at the surface with the gamma rays the treatment would have to be prolonged 300 times the time. This at the axis of the cone might be cut to 100 times the time were F included in the calculations for the axis of the cone. It is obvious that for deep treatments the gamma rays as used here would not work, for in treating the space 12.5 centimeter below the surface long enough to get effective results the surface would be severely burned. The difference in intensity at the surface and below due to the gamma rays could be reduced by increasing the distance of the radium above the surface. This, however, would increase the time of exposure many times. It is to be concluded that the usefulness of radium is greatest in cases where it may be applied right at the spot to be treated. For deep treatments where the distance of the radium from the surface is 6 or more centimeters the application lasts for many hours.

Finally in Fig. 5 we see the analogous diagram for the homogeneous x-rays. Here the focal spot of the anticathode is placed about 20 centimeters above the surface to be treated. The conditions assumed in making the calculations have been given elsewhere and it is possible that the total figure is somewhat high. However, one gets an excellent idea of how these rays act. At 1 centimeter below the surface the ionization is reduced to 81 per

Fig 5


Ionisation by X Rays
10 Mil. Amps. 90 Kilo-Volts Efficiency = 0.2%.
Total Ions in Cone = 1.5 x 10^14
Ions per cc per sec. in first cm = 1.5x10^13
Air 20 cm
.013% Total Ions Formed in Air
Tissue
1cm
Ionisation 81% of Init.
10% of Ions Here
5cm
Ionisat. 40% Initial
39% of Ions Formed Here
10 cm
20cm
Ionisat. 16% Initial
63% Total Ions in Cone Formed Here
Ionisat 3.5% Initial
86% Ions Formed Here
40 cm
Ionisat. 0.2% Initial
89% total Ions Formed Here

cent of its value at the surface in the cylinder. In the first centimeter of the cone about 10 per cent of the ions have been formed. At 5 centimeters the ionization has been reduced to 40 per cent of the ionization near the surface, while in the cone about 30 per cent of the ions that are formed in it have formed. At 20 centimeters below the surface the ionization has been reduced to 3.5 per cent of its former value in the cylinder, while 80 per cent of the ions have been formed in the cone. Here, owing to the greater distance from the source, the reduction of the ionization in the cylinder, due to the inverse square law, is much less than in the case where the radium was close to the surface. It is seen that the radiation is more rapidly absorbed here than in the case of the gamma rays though not much more so. In fact if the inhomogeneity of the rays had been included this absorption would probably be much more uniform throughout the space because the source is further away. The total number of ions formed in this cone is about 1.5×10^{14} ions per second, while the ionization per cubic centimeter in the first cubic centimeter is 1.5×10^{13} ions per cubic centimeter per second. It is obvious that the ionization per cubic centimeter is greater than that produced by either beta or gamma rays from 100 milligram of radium in their first centimeter which are 6.2×10^{12} and 3.4×10^{11}. Furthermore this marked ionization extends much further into the tissues, due to the methods of application. This means that the gamma ray applications with 100 milligrams of radium must be of the order of 100 times that of the x-rays to produce the same result. Thus for treatment of localities well below the surface which are inaccessible to the close applications of radium the x-rays are very efficient. However, they suffer from the defect that they affect pretty rigorously a mass of healthy tissue lying below and above the regions to be treated. This objection is circumvented in practice by radiating the localities from different angles, thus producing a maximum number of ions in the region to be treated.

The sketch which I have given will serve to demonstrate how even a rough calculation based on data taken for other purposes can give one a fairly precise knowledge of what treatment the tissues are getting under the different radiations when applied in a definite manner. In fact I believe that if some institution such as the National Bureau of Standards could be induced to set a physicist to work for a year or two in cooperation with the medical men in determining the constants needed for this type of computation, a set of tables could be derived which would give the ionization per unit volume produced by all radiations used under all conditions of treatment. Such tables

could easily be made accurate to within 1 per cent. With the ionization per cubic centimeter as a unit and with such tables the physician using radiation (either x-rays alone, gamma rays alone, or X and gamma rays combined) would then be enabled to fit his treatment to a given situation with the same ease and with the same relative precision for the objective in view as does the artillery man perform his gun-pointing evolutions from the tables computed for him. Some preliminary steps of this nature have been made in Germany for x-rays and some are being made in this country for gamma rays. However, it would be a great advantage, if, under the direction of the American Medical Association and the Radiological Society some *disinterested* institution such as the Bureau of Standards could be induced to take up the work in a systematic manner.

*This holds well within reasonable limits. Where exposure time t becomes so long that elimination of reaction products by the body as well as marked physiological changes can take place this no longer holds, e. g., in comparing the action of gamma rays from 200 mg. of radium for one hour with that of 4 mg. radium for 50 hours.

*—Read at the Annual Meeting of The Radiological Society at Chicago, December, 1920.

A New Type of Stabilizer For Use With The Coolidge Tube

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IN 1913 when Dr. Coolidge made the first tests of his hot cathode x-ray tube he found that to obtain a steady milliampereage through the tube he must keep the filament temperature steady. To this end, a storage battery was used as a source of current to heat the filament.

Storage batteries were all right in the laboratory but were far from satisfactory in the doctor's office for several reasons. The demand for something better led to the use of a "filament transformer". This device required no attention, was always ready for use and was so much better than the battery that it has now come into universal use. Substituting the filament transformer for the battery, introduced the factor of line voltage fluctuations and its effect on the temperature of the filament. To eliminate or neutralize these fluctuations various types of constant current transformers or stabilizers were devised with varying degrees of success (See Am. Journ. of Roent. Dec. 1915, page 891).

In all of these devices the aim was to hold a definite constant current through the filament regardless of line voltage fluctuations. This would prevent sudden changes in milliampereage through the tube due to line voltage changes, but would not take care of changes in milliampereage due to liberation of small quantities of gas in the tube during a long run.

With these facts in view it seemed clear that the ideal stabilizer would be one which would immediately correct any tendency toward a change in milliampereage caused by either line voltage or tube.

The following is a description of a new form of stabilizer which is operated directly by the high tension current which flows through the tube. Any change in this high tension current causes the stabilizer to act directly on the current flowing through the filament. If for any reason the high tension current through the tube tends to drop, the stabilizer immediately increases the filament current sufficiently to prevent the drop. The same holds true for a rise in high tension current; the filament current in this case is immediately lowered enough to keep the milliampereage at the desired value.

Fig. 1.—Shows diagrammatically the principle upon which the stabilizer operates. A is an electro magnet which is connected directly into the high tension circuit. All of the high tension current passes through this magnet. B is an iron armature which is free to vibrate when current passes through the magnet A. C and D are contacts. One of these is fastened to armature B and moves with it while the other remains fixed. These contacts are in series with the filament in the x-ray tube. There is also a small fixed resistance R which is connected across the wires leading to the contacts. S is a spring which pulls the armature away from the magnet.

The operation is as follows:

We will assume that a small current of say 1 or 2 M. A. is allowed to flow through the tube and magnet A. This current exerts a pull on the armature B, but if the spring S is sufficiently strong the armature will not move. Now if the current is increased to say 10 M. A. the magnet overcomes the tension of spring S, and the armature moves toward the magnet. The instant the armature moves contacts C and D separate and the filament current, which was purposely set at a higher value than that necessary for 10 M. A. now has to pass through the small resistance R. This resistance immediately lowers the filament current, which, of course, keeps the high tension current through the tube from going higher. This operation is repeated for each cycle of high tension current passing through the tube.

It will be seen then that the

DIAGRAM SHOWING
STABILIZER IN HIGH TENSION CIRCUIT

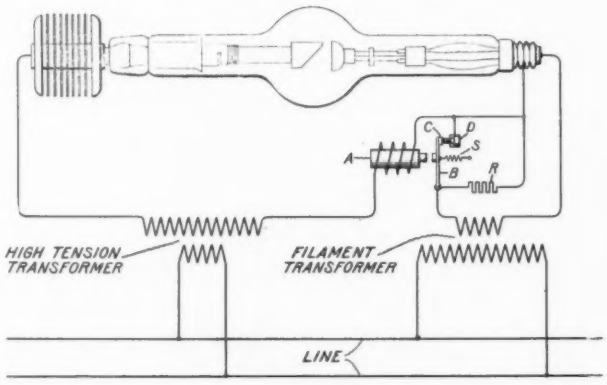


FIG. 1.

high tension current through the tube is controlled by the tension of spring S. If 20 M. A. is desired instead of 10 M. A., the tension of spring S is increased. More current now has to flow through the magnet before the contacts will separate. Instead of changing the tension of the spring to get more or less current through the tube, the magnet may be moved farther away from, or closer to, the armature B which

DIAGRAM SHOWING
STABILIZER IN LOW TENSION CIRCUIT

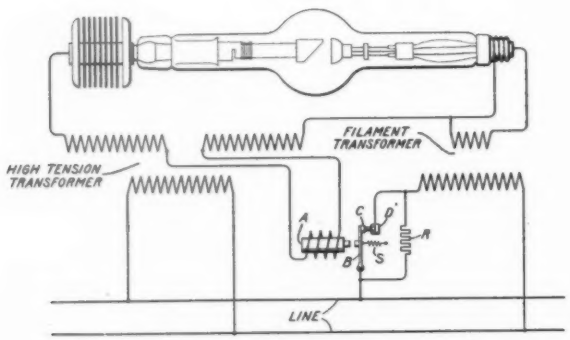


FIG. 2

accomplishes the same result, or the number of turns of wire on the magnet may be varied by means of one or more taps, or in other ways.

Fig. 2.—Shows another method of connecting the stabilizer to the tube circuits. In this case the magnet coil is connected to the center taps brought out from the high tension winding of the transformer and the contacts C and D are inserted in series with the primary of the filament transformer. The operation is the same in either case. On those transformers having no leads brought out from the center point of the high tension winding, it is necessary to connect the stabilizer in the high tension lead to the cathode of the tube as shown in Fig. 1. In this case the stabilizer becomes part of the high tension circuit.

Fig. 3.—Shows the effect of line voltage variations on a tube without stabilizer, and the same tube with the stabilizer in circuit.

Fig. 3.

Without Stabilizer.		With Stabilizer	
Volts	M. A.	Volts	M. A.
77	2.2	70	2.0
80	3.3	77	2.0
82	4.3	84	2.05
84.5	6.0	87	2.05
86.5	7.0	90	2.05
89.5	8.4	93.5	2.05
91.0	10.0	96.5	2.05
92.5	11.5	99	2.05
95	13.8	103	2.05
96.6	15.0	106.5	2.05

The stabilizer in this case was set for 2.0 M. A.

Fig. 4.—Shows how the stabilizer maintains the current through

a radiator type tube during a long exposure. The tube was first connected to a filament control rheostat in the regular way and the current adjusted to 10 M. A. Readings were then taken every half minute up to three minutes. The tube was then allowed to cool and the stabilizer connected in circuit. Current was adjusted to 10 M. A. and readings were taken again.

Fig. 4.

Without Stabilizer.		With Stabilizer	
Time.	M. A.	Time.	M. A.
0 Min.	10.0	0 Min.	10
½	9.6	½	10
1	9.3	1	10
1½	9.0	1½	10
2	8.7	2	10
2½	8.1	2½	10
3	7.0	3	10

lar lines in the filament current curve show the points at which the stabilizer contacts opened to prevent a further rise in milliampereage through the tube. It will be noticed that there is a break in the filament current curve for each cycle of current through the tube. This shows that the vibrating armature vibrates in synchronism with the alternating current supplying the tube. This is important. If the armature did not vibrate in synchronism, the filament current would not be adjusted to the correct value on some of the cycles, which would cause a variation in the milliampereage through the tube.

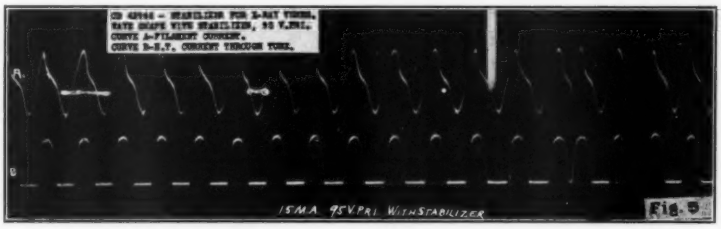


Fig. 5.—Shows a curve made with an oscillograph. The tube was of the self rectifying type. The lower curve represents a high tension current of 15 M. A. through the tube, and the upper one, the filament current taken at the same time. The small irregu-

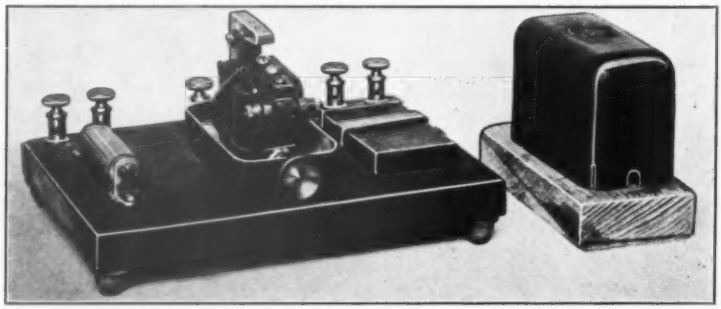
That the stabilizer does produce an even flow of current through the tube, even though the filament current is changed on each cycle. is shown by the evenness of the peaks of the waves in the lower curve, which is the curve of the high tension current.

Summary.

In the foregoing, a stabilizer has been described which is operated directly by the high tension current which flows through the tube. Using the milliampereage as the controlling element the stabilizer maintains the desired current through the tube regardless of changes either in the line voltage or in the tube itself.

It can be made small and it requires a negligible amount of energy for its operation.

It should prove useful wherever it is desirable to automatically maintain a definite amount of current through a Coolidge Tube.



*—Read at the Annual Meeting of The Radiological Society at Chicago, December, 1920.

Radiation and Thyroid Disease

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TO the earnest student of radiotherapy there is no more interesting subject than the history of this science, and as we are all radiologists here, it may not be presumptuous to discuss briefly its evolution. Let us treat the subject under the heading: "The Three Ages of X-Radiation. First came the static age, when, with our large static induction machines, we had a combination of high voltage and low amperage, hard tubes and long exposures. In other words, we were using rays of the gamma type, but did not know it. It was in this period that many brilliant results were obtained, mainly empirically, which gave x-ray therapy its rapid rise to fame. In the second, the coil age, we had more simple apparatus, more easily operated, but a distinct drop in voltage and softer tubes. This combination, coupled with the rather indiscriminate use of these machines by men untrained in Roentgenology, produced many x-ray burns and bad therapeutic effects. For these reasons, the expectations of cures, which had been so successfully inaugurated in the first, or static age, were not, on the whole, fulfilled. The third age is of fairly recent origin and was ushered in by the modern transformer and the epoch-making Coolidge tube. We have now learned that it is the energy of radiation from the gamma radium and x-ray which contributes most to a satisfactory end result. This period has shown the limitations of, as well as the indications for, modern x-ray therapy, and has placed the whole subject upon a sound scientific basis, which you and I are doing our best to develop.

Now, as to the application of radiotherapy to thyroid disease, in a recent address delivered to one thousand medical men, a very distinguished American surgeon stated that the x-ray was practically useless as a cure for goiter, and that radium was not of much greater aid, although he believed that a temporary inhibitory influence might be achieved by this agent in certain cases. Another equally distinguished European surgeon states definitely that the x-ray is practically a specific for toxic goiter, and to substantiate this quotes one hundred consecutive cases successfully relieved by this treatment under his observation. Other observers again claim

that radium is the best curative agent for this peculiar disease of metabolism, and cite numerous cases to prove their contention. In the face of such widely divergent views as these, the question is a pertinent one: What is the present status of radiation as applied to thyroid disease? Is it advisable to use the x-ray or radium or a combination of both in combating the disease?

It is not the purpose of the writer to go into the endocrin aspect of toxic goiter and other form of thyroid disease, but to give briefly the results of his own experience, extending over a great many years in the treatment of this malady by x-ray and radium. The first two cases in his records, where good results were obtained, were post-operative recurrences dating back to the static machine days of tube excitation, when if good results were obtained, it was partly by accident, but mainly because we were getting a very penetrating ray, the value of which we did not in those days appreciate.

In dealing with the toxic goiter we seem to be dealing with an organ functioning in a manner highly detrimental to the well-being of its possessor. Our knowledge of the potent action of radiation in discouraging abnormal cell activity is surely sufficient authority for its exhibition here. Radiation in these cases is not only indicated, but demanded, for where can you find another agent which will so surely inhibit and curtail the mischievous activity of these toxic cells, as radiation? It is not a question of carefully feeling your way with guarded application. It is a demand to lay down a radiation barrage, in which every pathological cell in the field must die.

In the treatment of toxic goiter, it is impossible to suggest an exact technique. In this class of cases, as in no other, the greatest possible variety occurs, and with the peculiar nervous manifestations which accompany them, care and good judgment must always be exercised in giving the treatment. As a rule, the modern deep x-ray therapy, pushed as rapidly as possible, is the proper procedure. It makes very little difference whether x-ray or radium is employed. In my own experience both give equally good results. Radium has one distinct advantage, particularly noticeable in the highly nervous cases, where the superiority of the innocent looking radium pellet over the large and complicated x-ray apparatus can be readily grasped. It seems to me that in the soft cellular enlargements, radium acts better than the x-ray. In the hard fibroid types, the x-ray is my choice. There are some conditions where both agents may be successfully combined. In the average case of toxic goiter, the x-ray technique is as follows: Six ports of entry,

four over the thyroid, and two over the thymus region, through each port thirty-five milliampere minutes, with four millimeters of aluminum and one half inch cotton filter, under compression, at an eight inch skin distance, and ten inch back up, three applications through each port within three weeks. This is usually sufficient to control the symptoms, and the patient returns in sixty days for inspection. In radium cases, the technique is as follows: Through similar ports of entry, one hundred milligrams radium element to each port for four hours, with one-half millimeter of silver and two millimeters hard rubber filter, one-half inch skin distance. This is repeated in ten days, after which the patient reports in sixty days.

A very few cases of hypothyroidism have been observed where fairly good results have followed a few light exposures for the stimulating influence on the gland.

I have a total record of about two hundred personal cases of toxic goiter, seventy per cent of which were treated with the x-ray alone, twenty per cent with radium alone, and ten per cent with a combination of both. It is impossible to give the end result of all these cases, owing to the fact that California is a land of restless people. The population is ever changing, and this migratory tendency makes it wholly impractical to maintain an effective follow-up system. Conservatively stated, the results have been in the main gratifying.

The importance of treating the thymus region cannot be overestimated. It is surprising to note how quickly a favorable response will follow radiation to the thymus before any direct applications have been made to the thyroid. It is perhaps hardly necessary to add that in addition to radiation, an intelligent supplemental treatment is insisted upon, such as a rational hygiene, with a proper amount of rest, a reasonable diet, and an avoidance of strenuous exercise or other physical acts which might be detrimental to the general health of the patient. It is also well to bear in mind that excessive menstruation and increased ovarian function may have a distinct bearing on the progress of hyperthyroidism. I have one particular case in mind, where, after a rather prolonged and intensive course of radiation to the thymus and thyroid, no appreciable response or amelioration of the symptoms could be detected. In this patient, the ovaries were subjected to one course of radiation, after which the toxic symptoms diminished at an astonishing rate.

It is not the intention of the writer to decry surgery, or to detract one iota from the many brilliant results obtained by competent operators, but the fact must

not be lost sight of that in radiation we have a proved therapeutic agent, far superior to any other given us up to the present time. The oft repeated statement that radiation over any field creates so much vascularity, or produces so many adhesions that surgery is rendered more difficult is entirely false. Radiation always diminishes vascularity in any region where it is applied long enough to have its obliterating effect on the arterioles established, and this is the essential status required in the successful termination of toxicity in this variety of goiter. There is surely no longer any excuse for denying a patient the use of this remedy, which if not successful, has at least prepared the way for possible surgery.

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Radiotherapy Versus Operation in Cancer of the Cervix Uteri

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IT is a privilege to present the question of the best treatment for cancer of the cervix uteri to a body of expert surgeons. In a gathering of this kind one may at once proceed to the very heart of the problem and one may safely take for granted that the paramount importance of an early diagnosis and the pressing necessity of continuously spreading information among medical and lay circles are fully appreciated.

Let us first agree on definitions. It is now generally accepted that five years must elapse after an operation before we can pronounce the patient as permanently cured. This time limit is somewhat arbitrary, but it serves all practical purposes because recurrences after five years are met with only in a very small number of cases. It has been suggested to reduce this time limit for radiotherapy to three years, but experience has disproved the claim that return of the disease was not likely to occur after three years. If we are to compare the value of the two methods that are at present competing in the treatment of cervical cancer, it is best to adhere to the five-year limit in both the operated and irradiated cases.

The terms "operability" and "inoperability" are products of the exclusively surgical era of treatment and have lost their meaning to a great extent since radiotherapy made its appearance. Moreover, operability by no means denotes a fixed quantity. The percentage of so-called operable cases ranges within wide limits in different statistics, because it is largely dependent upon the subjective attitude of the individual operator. One surgeon will subject to operation cases which another may consider too far advanced for a permanent cure. In one case, personal skill and extensive practical experience will overcome technical difficulties which to another surgeon may appear insuperable. For the present, however, we may retain these terms for a more convenient grouping of the cases and we may classify—

1. As operative, those cases in which the cancer is strictly limited to its original site and where the most careful recto-vagino-abdominal palpation fails to reveal any extension of the

disease which would interfere with the free mobility of the uterus;

2. As borderline cases, those in which the cancer has only begun to invade the vesico-vaginal and recto-vaginal septa, and the parametria in close proximity to the uterus; where the uterus is still movable though to a lesser degree, and where glands may be palpated before or during operation, which, then, may become merely a palliative intervention, and the case will have to be assigned to the group next in order;

3. As inoperable, those cases in which the uterus is immured in its position by the involvement of a large part of the pelvic cellular tissue, and where adjoining organs have been invaded or metastases are found in remote parts of the body.

In the final appraisal of our surgical treatment we distinguish between an absolute and a relative cure. The percentage of absolute cure is obtained by computing the number of all patients with cancer of the cervix uteri who applied for treatment, with the number of those still alive and well after five years. The percentage of relative cure is derived from the ratio between the cases which have actually been operated upon, and those who thereafter remained alive and well at the end of five years. This percentage incidentally enables us to estimate the value of the particular method employed.

This distinction is not equally sharp in radiotherapy where almost all cases, whether operable, borderline, or inoperable, are subjected to treatment. The percentages of absolute and relative cure after radiotherapy will, therefore, be very similar or even identical. It may, then, become necessary in future to compare only the percentages of absolute cure from the two methods.

By operation is meant only the radical abdominal hysterectomy which bears Wertheim's name, though Ries, of Chicago, originated the idea, and Clark, of Philadelphia, Bumm, of Berlin, and a host of others had a great deal to do with perfecting its technique. There is a tendency among certain men to call a Wertheim operation any abdominal hysterectomy undertaken for cancer; but in this audience the fallacy of confusing a simple with a radical abdominal hysterectomy is obvious. The extended or radical vaginal hysterectomy of Schauta enters in competition with the Wertheim operation, but in this country, at least, it has never become popular enough to attain practical importance.

By radiotherapy is meant the employment of radium and x-rays, either alone or combined.

A witty Frenchman once remarked that if men who were about to launch into a discussion,

would first agree on definitions, there would be no discussion. This, I hope, will not be the case today, but trust we shall at least all talk about the same things.

We can now proceed to take stock, as it were, of the actual results achieved thus far by the various methods under discussion. As we want to inquire how many cases we can cure, we must leave out the inoperable ones, which are abandoned as hopeless by surgical means, and confine ourselves to the operable and borderline cases.

Table I gives a survey of the *relative* cures after abdominal operation.

TABLE I.

Berkeley and Bonney	39.0%
Bumm-Sigwart	26.3%
Bumm-Schaefer	41.8%
Curtis	34.0%
Doederlein	28.0%
Franz	43.0%
Graves	27.6%
Jacobson	23.4%
(Eighteen American operators)	
Kroenig	32.2%
Peterson	47.3%
Sellheim-Mayer	31.0%
Wertheim	42.4%
Zweifel-Aulhorn	45.0%

On an average, then, 35.5% of the patients operated upon by the abdominal route, were alive and well after five years.

Table II. gives the percentages of *absolute* cure after abdominal operation.

TABLE II.

Berkeley and Bonney	24.3%
Bumm-Sigwart	16.0%
Bumm-Schaefer	32.3%
Doederlein	17.0%
Franz	28.0%
Graves	16.8%
Kroenig	25.3%
Sellheim-Mayer	20.0%
Wertheim	18.3%
Zweifel-Aulhorn	23.4%

This list shows that, on an average, the abdominal operation yields an absolute cure of about 22 per cent.

The vaginal operation produced, according to the statistics of Schauta and of Adler, a relative cure of 53.3 per cent and an absolute cure of 22 per cent.

Table III. shows the *relative* cures obtained with radium in operable and borderline cases.

TABLE III.

Baisch	28.5%
Bumm-Schaefer	25.0%
Eckelt	14.0%
Kehrer	45.4%
Taussig	31.5%

(Collective statistics of twelve operators.)

It appears from this list, that the average percentage of relative cure after radium treatment in operable cases is 24.7.

In Table IV. the figures for the *absolute* cure of operable and borderline cases after radium treatment are given.

TABLE IV.

Baisch	16.5%
Bumm-Schaefer	14.0%
Eckelt	7.0%
Kehrer	22.0%
Zweifel-Schweitzer	25.0%

This gives on an average an absolute cure of 16.5 per cent in this class of cases.

In a number of the cases in the two preceding tables radium was used in combination with x-rays. There are several reports in literature dealing with the *exclusive* x-ray treatment of operable cancer cases, but as the time limit of five years has not yet been reached, these statistics were left out of consideration.

The figures given above permit of certain deductions.

To begin with, Tables III. and IV. definitely dispose of the statement heard now and again that no case of cancer of the cervix has ever been cured by radium. Whatever doubt as to this point may have been in the minds of those who remained sceptical at first, is now set at rest.

The percentages both of the relative and absolute cure after radium treatment are lower than the corresponding percentages after abdominal operation. This difference may lead to the hasty conclusion that operation in itself is preferable to radiotherapy. But an unbiased examination must take into account the following points.

(1) The abdominal operation, in its present form, is almost twenty years old. Many thousands of cases have been operated upon, and the practical experience of the individual operator has increased from year to year. The primary as well as the late results laid down in statistics, reflect this growth of technical perfection. It may be assumed that the acme of surgical achievement in this class of cases has been reached.

Radiotherapy, on the other hand, has just now completed the fifth year of its existence. Its technique is still in a state of flux. We are only learning how to use these mysterious agents of radium and x-rays, and from analogy with our experience in the surgical treatment, we may confidently expect better results from radiotherapy as time goes on. As a matter of fact, one authority at least (Kehrer) has already accomplished results with radium that are in every way identical with those derived from surgery.

(2) Granting, however, for the sake of argument that radium cures fewer cases than does the operation, we find illuminating information on closer scrutiny of the statistics. In a collective review on the subject, Taussig very interestingly pointed out that in Doederlein's clinic 49 out of 110 early cases were cured by operation (44.5 per cent) whereas only 6 out of the 57 borderline can-

cers were cured (10.5 per cent). By radium, on the other hand, 17 out of 40 early cases were cured (42.5 per cent), while 14 out of 62 advanced ones were cured (22.5 per cent). A very similar proportion was ascertained in the material in Bumm's clinic. Taussig, therefore, concludes that while the percentage of surgical cures is greater in the early operable group, the percentage of radium cures is greater in the borderline group.

(3) The question of primary mortality must be taken into account. Graves, of Boston, has an amazingly low operative mortality of 5.2 per cent, which compares favorably with the best results obtained abroad. But the average mortality in Germany and England is still in the neighborhood of 20 per cent, and in general surgical practice in this country is probably much higher —so high, indeed, that several of my surgical friends have altogether abandoned the radical operation.

The mortality after radiotherapy is very low. Even the most enthusiastic advocates of radiotherapy will nowadays admit a mortality though it probably remains below 3 per cent. It is fair to assume that with greater practical experience this mortality will be still further reduced.

Applied to our problem, this difference in mortality makes up somewhat for the inferior final results. It means that one may resign oneself to less brilliant late results if one does not have to pay so high a toll in human lives.

These points have been raised to show that it is not advisable to conclude at once from the statistics that operation should be preferred to radiotherapy.

But the main issue, to my mind, is this: Is it permissible to construe any antagonism between the two methods? Should the question before us be: *Either* operation *or* radiotherapy? We know now that both methods can, and do, produce a permanent cure. Why not, then, combine the two methods in order to get the best possible benefit?

This is my personal attitude in this question, and in order not to delay any further a free exchange of opinion from which we may learn a great deal, let me briefly outline my own opinion.

I now believe, as I formerly doubted it, that radium alone may cure an early case of cervical cancer. I realize, however, that the penetrating power of radium does not exceed 3 to 4 centimeters. Beyond this distance, the radium rays are either inert or they are so weak that they stimulate cancer cells instead of destroying them. Hence the pelvic glands, which are at times involved even in the earliest cancers, cannot be influenced by radium. For this reason, I prefer at present for early cases the

abdominal radical operation. In every case, the operation is preceded by a moderate dose (2,500 to 2,800 miligram hours) of radium applied within the cervical and uterine canals or buried in the tumor mass. Operation is performed after the radium reaction has subsided; 7 to 10 days later. In this time the ulcerated surface becomes cleaner and the tumor somewhat smaller; a few preliminary acetone treatments may hasten the process. This single treatment with radium screened as it is by the uterine walls, neither causes an undue degree of hyperemia nor reactive sclerosis of the pelvic tissues. After the operation, when the patient is well on the road to recovery, that is to say, in about three weeks, massive x-ray treatment is given to destroy any cancerous foci in the pelvis which may have remained behind, or to deal effectively with any freshly implanted cancer material. I have given up radium for post-operative treatment because of the repeated occurrence of fistulae.

Or take a borderline case of mild degree, where the uterus is still movable and the parametria are uninvolved. The disease has extended only towards the bladder, and on cystoscopic examination the vesical mucosa is found normal, but the vesico-vaginal septum involved. Our operative experience has taught us that such a case is predisposed to an early recurrence in the bladder wall, even if the dissection of bladder and vagina was successful. The preliminary treatment with radium will probably cope with the cancerous involvement in the vesico-vaginal septum and render the case readily operable. The operation, then, will be followed by energetic x-ray treatment in the manner described.

In all other borderline cases which are further advanced, I reject operation in the firm belief that combined radium and x-ray treatment will in the end yield better results with a minimum of danger, suffering, and annoyance. I cannot give any exact figures from the services of Dr. Taussig and myself at the Barnard Free Skin and Cancer Hospital, because we have had radium only in the last three years. But the signs are propitious in every way. We see early cases in increasing numbers every year, because the very existence of an institution such as ours attracts the attention of patients at earlier stages of the disease, and because our hospital has conducted a vigorous educational campaign. In our operative material, the primary mortality has declined steadily, and since the introduction of combined surgical and radio-active treatment, we believe to have observed fewer recurrences. On the whole, we have reduced rather than increased the number of operations, because most of

the borderline cases have been subjected only to radiotherapy. In these cases, as well as those which were frankly in the inoperable category, our results have been particularly encouraging and will induce us to continue to work along the lines indicated and to concentrate our efforts on technical improvements of our radiotherapeutic measures.

I am well aware that the foregoing discussion does not cover the entire problem before us. The time alloted to me and the endurance of the audience both prohibit. The desirable and the undesirable by-effects of radiotherapy have not been mentioned, nor was the question of surgical and radiotherapeutic injuries touched upon. The awful problem of the inoperable case was omitted as not being within the scope of our inquiry, and for the same reason the cancer of the uterine body received no consideration.

What really matters in this afternoon's debate and what should form a basis for the discussion, can be condensed in the following propositions:

1 Cancer of the cervix uteri can be cured permanently, both by radical operation and by radiotherapy.

2 The former yields an absolute cure in 22 per cent, the latter in 16.5 per cent.

3 The present inferiority of radiotherapy in the permanent cure of cervical cancer is probably due to the deficiencies that characterize any new therapeutic method.

4 Even the highly developed surgical treatment restores life and health only to about one-fourth of the patients who seek our aid.

5 The present state of our knowledge seems to indicate that a further and much desired improvement of our curative efforts may result from combining operation with radiotherapy.

6 It is, therefore, inappropriate to speak of the two methods as so opposed that only one or the other of the two should be selected. Rather should we attempt, in future, the treatment of cervical cancer by operation and radiotherapy.

7 The writer's personal attitude for the present is this: Early cases receive a pre-operative application of radium and a post-operative treatment with x-rays Borderline cases are treated altogether by a combination of radium and x-rays.

*—Read at the Annual Meeting of The College of Surgeons, Nebraska Section, Omaha, March 3, 1921.

Roentgen Observations Before and After Cardiolysis in a Case of Chronic Mediastinopericarditis.

EDWIN C. ERNST, M. D.
St. Louis, Mo.

IN view of the fact that the pre- and post-operative findings in chronic mediastinopericarditis have been reported rather infrequently, American medical literature containing less than five authentic cases, and likewise realizing the importance of the fluoroscopic interpretations as an aid to the early recognition of this type of pericardial pathology, including the valuable sign of cardiodiaphragmatic "tugging", we present and describe this case.

The x-ray observations by such careful clinicians as Moritz Benedikt (1897), Stuertz, J. E. Summers and Brauer have been very incomplete, especially the findings following cardiolysis, and we therefore have attempted to describe in detail the numerous distinct phases of this particular case, the first symptoms of which presented themselves some twenty-two years ago.

In 1898, Mrs. D——., age 38, Case 5135, came under the observation of Dr. Ellsworth Smith, [1] suffering from mitral insufficiency, which apparently followed an earlier attack of polyarticular rheumatism. However, at that time a course of artificially prepared Nauheim Bath Treatments [2] gave the patient almost immediate relief. The extensive anasarca was rapidly reduced and the cardiac compensation was likewise completely restored. The patient returned to her occupation in a book bindery and continued her work successfully fifteen years up until the onset of her present trouble, the beginning of the second phase of her partial disability.

Second Phase (1913)

This second period of illness began in 1913, with a return of dyspnoea and inability to sleep lying down, which condition continued without showing any improvement during the following six years. Dr. Smith again examined the patient in February, 1919, and observed that she presented an entirely new symptom complex. Instead of being generally water-logged, as in 1898, approximately fifteen years previous, she now manifested an extensive ascites with practically no adema of the lower extremities, presenting an entirely new problem from every standpoint than

the one observed during her first illness. Three gallons of fluid were removed during two sittings, and this was later followed by at least twenty additional tappings. During the past two years paracentesis was repeated every five or six weeks. At no time was the patient able to sleep unless propped up in bed.

Third Phase (1918)

An operation was finally advised in May, 1918, based on the diagnosis of hepatic cirrhosis. Consequently, in May, 1918, a modified Talma operation was performed, but without beneficial results. Dr. C. A. Wood reported all of the organs in the abdomen as being normal. The case was further examined at Barnes' Hospital in view of the negative operative findings, at which time the differential clinical findings were again reviewed by Dr. Smith, as follows:

"A repetition of her first attack of cardiac decompensation from valvular disease could be excluded from the presence of ascites with an absence of general anasarca. Peritoneal tuberculosis could also be excluded; first, on finding the peritoneum normal at the time of the Talma operation; secondly, on the absence of fever and emaciation; thirdly, the long course of the disease. Laennac's cirrhosis of the liver was excluded; first, by the absence of any etiological factors, as alcohol, use of strong condiments, etc.; secondly, by the absence of progressive loss of weight and strength during a period of six years. Cirrhosis due to chronic hepatic stasis is generally not recognized by pathologists. Therefore, by exclusion the diagnosis simulated a chronic condition of mediastinopericarditis; but inasmuch as the roentgen findings thus far reported had been negative and the physical signs not entirely typical, we did not feel justified in advising another operation. Consequently, the patient returned to her home.

Fourth Phase (1919)

However, seven months later the patient's clinical condition entered its fourth phase. On December 6th, 1919, entered St. Luke's Hospital and reported her condition as gradually growing worse. The previous clinical observations were again confirmed by Dr. Smith, but in addition at this time definite fluoroscopic evidence of an adherent pericardium was fortunately obtained. These findings could only be observed with the patient in a semi-oblique position, by which method it was possible to observe very graphically a distinct "tugging" upward of the diaphragm with each cardiac systole. The complete roentgen observations on December 19th, 1919, were as follows:

Roentgenological Findings, December 19, 1919

The fluoroscopic examination of the chest shows evidence of an increase in the heart shadow, both toward the right and left margins, more pronounced toward the right side. Then general cardiac enlargement is irregular and very suggestive of pericarditis with effusion. However, further observations do not reveal the usual characteristics of fluid within the pericardium. The cardiac pulsations could be clearly observed, and the position of the heart was unusually high in the chest cavity. It was very apparent during deep inspiration that the left diaphgram was more or less fixed toward the apical shadow of the heart, being pulled upward or tugged in synchronism with each heart throb

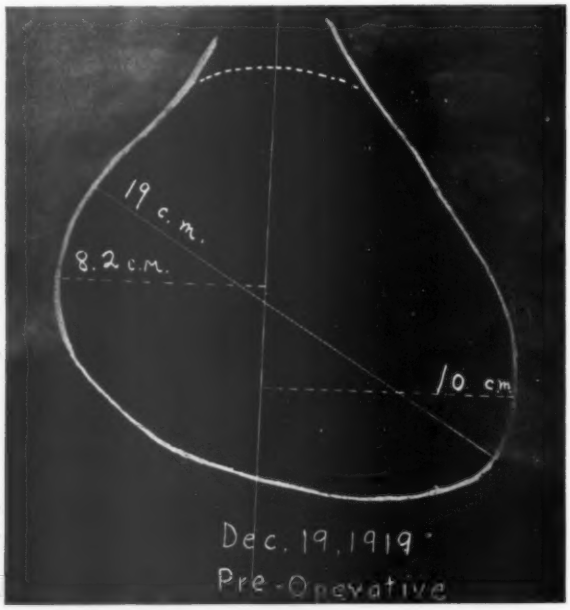

Fig. 1—December 19, 1919. Pre-operative radiogram of the cardiac shadow at one meter target plate distance. The fluoroscopic observations of the left cardio-diaphragmatic "tug" previously described cannot be outlined in the above radiogram. However, the increase in size and the high fixation of the cardiac shadow in the thorax are interesting diagnostic findings. Cardiac measurements were as follows: oblique diameter 19 cm., left transverse diameter 8.2 cm., right transverse diameter 10 cm., total transverse diameter 18.2 cm.

These observations were more pronounced following rotation of the patient in the semi-oblique position, while the apex shadow was in close proximity to the fluoroscopic screen. This "tugging" was accentuated during

deep inspiration, forcibly pulling the left diaphragm for a distance of at least three centimeters with each pulsation of the heart. Further observation along the heart margins did not reveal similar fixations, with the exception of an area along the left superior ventricle border of the heart, at which point very moderate traction of the lung markings could be observed. However, the fixation was not very marked and not nearly so graphic as those observed in the apical region of the heart. The posterior mediastinal space density was definitely increased.

The radiographic observations corroborated the above findings, with the exception of the fluoroscopically observed left cardiodiaphragmatic tug. The actual fixation could not be visualized on the radiographic plate. The oblique diameter of the heart was 19 centimeters, while the transverse diameters totalled 18.2 centimeter, at the usual one meter target distance.

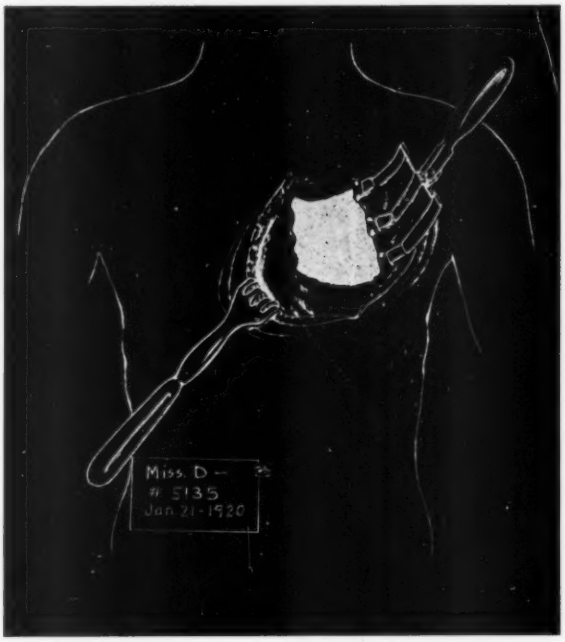

Fig. 2—Cardiolysis (Brauer's operation). Resection of the third, fourth and fifth ribs and cartilages in order to free the pericardium from its adhesions to the periosteun of the anterior chest wall. The adhesions were not directly severed, but the fixed bony structures were removed to allow the heart to descend to a lower level in the thoracic cavity, thereby relieving the anterior tension on the pericardium. Operation by Dr. Harvey G. Mudd.

Operation

In view of the above clinical and more recent conclusive Roentgenological findings, cardiolysis (Brauer's operation), was finally advised, and Dr. Harvey G. Mudd operated on January 21st, 1920, under a local black anaesthesia. A resection of the third, fourth and fifth left ribs was made for a distance of from three to four inches, beginning along the left border of the sternum and extending toward the axilla slightly beyond the limits of the cardiac pulsations. Immediately following the removal of the ribs and cartilages, Dr. Smith reported that a distinct and extensive pulling in of the soft parts with each systole of the heart could be seen, showing what difficulty the organ must have encountered before the operation in attempting a complete systolic contraction. Although convalescence was not uneventful, nevertheless on March 20th, 1920, two months following the cardiolysis, the patient's general recovery was remarkable. It was now possible for her to lie flat in bed and sleep all night, something she had been unable to do since the onset of her present trouble, the second phase of which began in 1913, seven years previous.

Dr. Smith further reports that while for a period of two years antedating cardiolysis she had required tapping every five weeks, a period of over twenty-two weeks has now elapsed without necessitating paracentesis, and her abdominal measurements have been reduced approximately six inches. The effect of digitalis upon this heart is likewise of great interest, for before operation the digitalis effect can be shown only in the removal of a small pulse deficit and a faint slowing of the apex rate, but with slight diuresis. While after the operation, we not only have a slowing of the pulse and obliteration of pulse deficit, but also a definitely marked diuresis. In addition to the above post-operative, laboratory and clinical findings we wish to report the subsequent fluoroscopic and radiographic observations, which were made two and nine months respectively following the cardiolysis.

Post-Operative Roentgenological Findings March 20, 1920

The fluoroscopic examination of the cardiac shadow two months following the cardiolysis operation does not show evidence of the previously observed left cardiodiaphragmatic tug at the apex. The radiographic examination does show evidence of a slight decrease in the size of the heart shadow and a definite rotation of the right side of the heart upon the avis of the apex. The position of the heart is somewhat lower than even the left apical region. The oblique diameter of the heart has decreased to 18.2 centimeters and the transverse diameter to 17.8 centimeters.

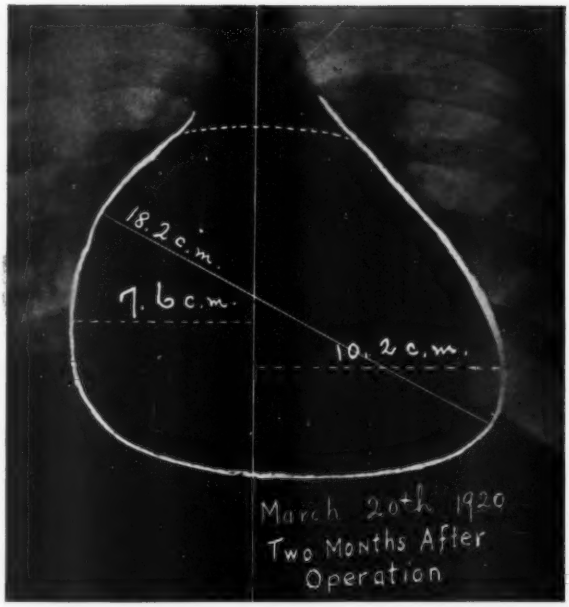

Fig. 3—March 20, 1920. Post-operative radiogram two months after cardiolysis. Note the decrease in size of the cardiac shadow. Oblique diameter 18 cm., left diameter 10.2 cm., right diameter 7.6 cm., total transverse diameter 17.8 cm. Target plate distance one meter. The position of the cardiac shadow can now be observed to be considerably lower in the thoracic cavity as compared with the pre-operative radiogram, Fig. 1. In addition, the right auricle and ventricle are likewise rotated downward upon the apical axis of the heart. The fluoroscopically observed cardio-diaphragmatic tug was absent,

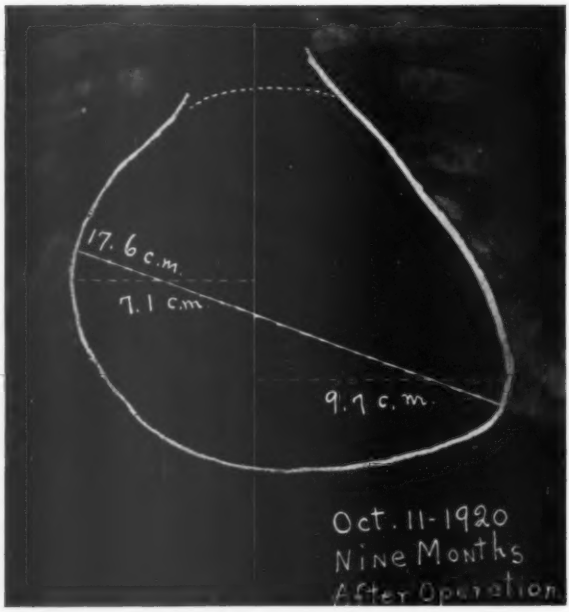

Fig. 4—October 11, 1920. Post-operative radiogram nine months after cardiolysis. A comparison of the present measurements with those observed in the pre-operative cardiac shadow shows evidence of a reduction in size of 1.4 cm. in both the oblique and the total transverse diameter. The inferior rotation of the heart, however, is comparatively increased. The cardio-diaphragmatic tug continues to be absent. One meter target plate distance.

Post-Operative Roentgenological Findings, October 11, 1920

The second post-cardiolysis fluoroscopic examination, nine months following the above operation, corroborated the previous observations. The heart shadows in both the oblique and transverse diameters were further decreased, the total transverse diameter now being 16.8 centimeters, while the oblique was decreased to 17.6 centimeters. It is interesting to note that both the oblique as well as the total transverse diameters were equally reduced 1.4 centimeters. The position of the heart continued to be slightly lower in the thoracic cavity and the inferior rotation of the right side of the heart was still more pronounced. On December 14th, 1920, another fluoroscopic observation was made and it was interesting to note the depth of the excursion of the left diaphragm during deep inspiration without evidence of the "tugging" sign.

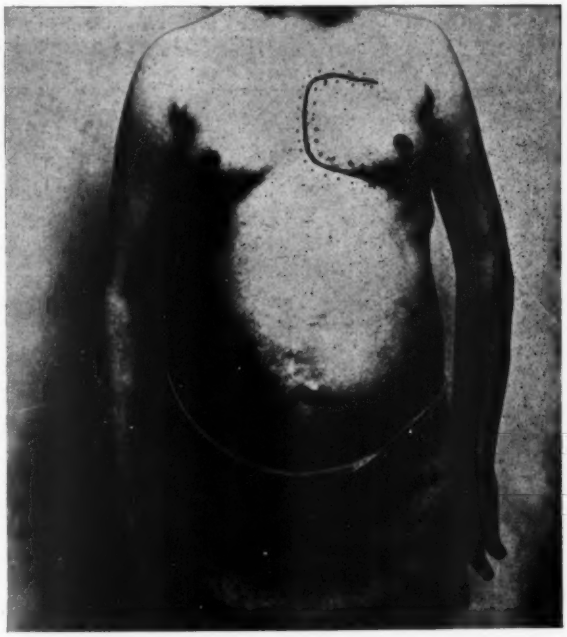

Fig. 5—Post-operative field after cardiolysis. Mrs. D., Case No. 5135, nine months following the previously described operative procedure.

In conclusion, we wish to state that the limited time at our disposal will not permit a discussion of the pericardial pathology in this case and at the same time be able to review the many radiological signs and methods employed

in making a differential diagnosis to definitely determine the indications and contraindications for Brauer's operation. The fluoroscope, however, is essentially the most valuable aid in attempting to determine first of all the type of the pericardial pathology. A large heart hanging moderately high in the thoracic cavity, together with definite evidence of cardio-diaphragmatic tugging at the apex with each systole of the cardiac cycle for a distance of several centimeters, are in themselves invaluable roentgen findings and possible indications for cardiolysis.

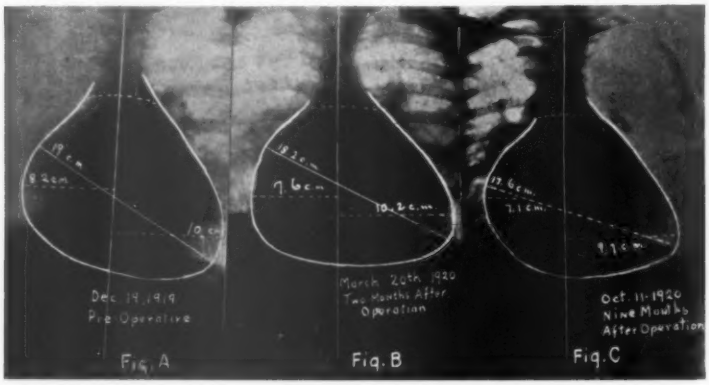

Fig. 6—Graphic comparison of the three stages before and after cardiolysis in the case just described of chronic mediastinoperaicarditis. (a) Before operation. (b) Two months following cardiolysis. (c) Nine months following cardiolysis. The size of the heart has been decreased, while the position and inferior rotation of the cardiac shadow has become progressively more pronounced.

A final examination of this patient was made fourteen months following the above mentioned operation, both from the physical and roentgenological standpoint. The combined reports of these findings show further evidence of continued physical improvement. In fact, the patient entered the fluoroscopic room dancing, apparently enjoying normal health, and spoke enthusiastically of her ability to sleep in comfort lying down, something she had been unable to do for a period of seven years. The fluorocopic examination did not show evidence of the previously observed cardio-diaphragmatic "tugging." Paracentesis has been resorted to on but one occasion during the past seven months, although previously this operation was necessary at intervals not exceeding five weeks. The above radiographic, fluoroscopic and clinical findings observed fourteen months following the cardiolysis operation, are in themselves evidence as to the value of the diagnostic methods employed and the procedure adopted

to relieve this type of cardiac pathology.

Conclusions

1—Chronic mediastinopericarditis is a condition which, if allowed to progress, will certainly reach the stage when operative measures will prove valueless.

2—Cardiolysis is a valuable aid in obtaining relief from chronic mediastinopericarditis, provided such a measure be adopted during the early stages of this condition.

3—Therefore, an early diagnosis is primarily essential, and the roentgen ray offers the necessary advantages to the early discovery of such pathology.

4—It is likewise of equal importance that the systolic cardio-diaphragmatic tug be differentiated from the not infrequently observed slight pulling upon the diaphragmatic pleura.

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(1)—To whom I am indebted for referring this case and for the use of all the clinical data herein contained.

(2)—As reported by Dr. E. Smith: Schott Bath Treatment of Chronic Heart Disease, Journal of the American Medical Association, Vol. XXXII., p. 161.

*—Read at annual meeting of the Radiological Society of North America, Chicago, December, 1920.

Journal of Radiology

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Mid-Summer Meeting

EVERY meeting of The Radiological Society has certain peculiar characteristics. In a word, then, the mid-summer meeting held at Boston last month will live in retrospect for its subtle yet virile enthusiasm, for its delicate though profound inspiration—a meeting where ideals fructified, hope assumed form, and the gathering impetus of the years laid a positive urge against scientific knowledge for future achievement.

Quite simply, the mid-summer meeting served to impress on the minds of all, the distinctive part Radiologists will inevitably take in the larger career of all medical men.

Those in attendance—and they were many, because they numbered the largest registration ever recorded at a summer meeting in the history of The Radiological Society—came athirst for knowledge. Their evident sincerity of purpose, combined with an avowed respect for and appreciation of labor performed, their prompt attendance and studious mien, all served to provide incomparable stimuli for speakers and officers, galvanized past accomplishment into unequivocal promise that the progress of Radiology shall go forward unfettered.

Reviewing the two-day session briefly, it may be said that the mid-summer meeting was one at which, speaking strictly of shop, the various aspects of the newer therapeutic technique were elaborated on the physical side by such eminent authorities as Dr. N. E. Dorsey, Dr. W. D. Coolidge, and Dr. A. W. Erskine, while the clinical application of facts obtained through physical research was discussed exhaustively by Dr. James D. Murphy and Dr. A. F. Tyler. There were also many interesting and informative discussions concerning the different phases of x-ray and radium therapy and diagnostic problems in all branches of the profession.

The original papers will be published at length in future issues of The Journal.

Mention must also be made of the banquet on Friday evening, at which Dr. Patrick F. Butler of Boston so ably officiated as toastmaster, a fact which in and of itself proclaims an evening of rare good fortune. At the speakers table were such distinguished gentlemen as Dr. Harvey Ward Van Allen, president of the New England Roentgen Ray Society; Dr. Henry Schmitz, president of the American Radium Society; Dr. Arthur Carlisle Christie, president of the American Roentgen Ray Society; Dr. A. W. Barclay, representing the Roentgen Society of London; Dr. Alexander H. [illegible] president of the Canadian Radiological Society; Dr. W. D. Coolidge, Dr. Frank E. Bissell and Dr. I. S. Trostler.

It is perhaps well to record here, and to emphasize, the kindly feeling of the Radiological Profession of England toward the Radiological Profession in America, revivified so forcefully by Dr. Barclay, who stressed the value of close, personal inter-acquaintance, sketched the important work

yet to be done, and bade us Godspeed.

Likewise Dr. Christie's plea for co-operation between Radiologists, between Radiologists and Physicists, between Radiologists and Clinicians is worthy serious consideration, because thereby Dr. Christie believes, much needed changes in medical practice acts, in insurance problems, in furtherance of scientific research, can be accomplished.

To our own president, Dr. Williams, and to the committee on local arrangements, especially Dr. Butler, much is due. The entire program was altogether so well balanced, the arrangements were all so thoughtfully and perfectly made, and the registration so carefully and efficiently handled, that the harmony and spirit of the ensemble engendered a wholesome spirit of good fellowship that was at once both infectious and invigorating.

No one who attended the mid-summer meeting will dispute the fact that its dominant result was an extended professional horizon, an increased vision of the potential possibilities latent in the correlated aspects of diagnostic Radiology, and an unconquerable desire to go forward in an ever widening influence of service founded on scientific fact.

Canadian Radiological Society

WITHIN the sound of that magnificent Colossus of the eternal verities—and while Gamma and Beta rays scintillated iridescently by day or mellowed in greenish hue at eventide, the Radiological Society of Canada held its first annual session at Niagara Falls, Ontario, May 31st and June 1st.

Here was symbolism! The placid waters of a thousand insignificant streams merged into a rushing compound of energy which perpetually separates two mighty nations, yet links them irrevocably as one people in a Herculean effort at mastery—the placid thoughts of individuals crystallized and energized by impact with the implacable zeal of a united profession seeking the truth.

That The Radiological Society of North America will have to look carefully after the preservation of its own laurels, those which distinguish it as a progressive organization was conclusively demonstrated.

The spirit of the Canadian organization is manifestly one which will carry it a long way toward the accomplishment of those things too often viewed as Utopian. The meeting was well attended and the program was excellent. Arrangements have already been made for publishing the papers read at the meeting in the Dominion Medical Journal.

But this is not all of the story. The Canadians planned a happy surprise, both unique and unparalleled in the annals of medical history, by conducting a two-day session at Niagara, and an adjourned two-day session at Boston in conjunction with The Radiological Society of North America, to which latter point they went by special train en masse.

To the retiring president of The Canadian Society, Dr. Alexander H. Pirie of Montreal, and to Dr. L. K. Poyntz of Victoria, who succeeded himself as secretary, there is due a very real and sincere expression of gratitude. And to the new president, Dr. G. E. Richards of Toronto, felicitations are extended over the distinct preferment of being selected as worthy the leadership of so unusual an organization.

When men undertake important things with the assurance and unbounded vigor with which the Canadians set about the formation of their Society, its first annual meeting, and the trip to Boston, there is every reason to believe they will accomplish

much for their own benefit and the benefit of the medical profession everywhere.

The Radiological Society of North America is glad that among its members are most of the members of The Canadian Society, for in that fact is found a tangible basis for belief in the ultimate achievement of those things to which all aspire.

American Radium Society

DR. HENRY SCHMITZ, retiring president of The American Radium Society, performed a highly significant thing, when, at the sixth annual meeting of that Society in Boston, he invited Dr. Alden Williams, president of The Radiological Society of North America, to speak.

Every Radiologist, of course, knows that radium has a very proper place in Radiology, just as the x-ray has a proper place in Radiology.

But in the hurrying and scurrying of every day life, when demands on one's time and energies are so multitudinous that occasionally one would fain fly away and forget it all, it is easy to become partial to the one or the other; and in the ardent advocacy of the one to the exclusion of the other, obstruct the attainment of the most satisfactory results.

That is why Dr. Schmitz's act was really a significant event; it gave public recognition to the inter-relationship, one might almost say interdependency, of radium and x-ray in the intelligent treatment and obliteration of disease.

It is a recognized fact that all medical organizations should coöperate in every conceivable manner for the betterment of all by the exchange of ideas and newly discovered facts. But this coöperation too often takes the form of mere lip service; and in view of the greater necessity for intimate association and effort by organizations and societies striving to accomplish identical purposes and moved by identical ideals, it is sincerely to be hoped that the incident which is the subject of this article is but the forerunner of mutual helpfulness like which the profession has never known.

Much beneficial discussion was indulged concerning the physics underlying the action of radium on the tissues, and Wm. Duane, Ph. D. of Harvard delivered a very commendable thesis making "A Comparison of X-rays with Gamma Rays of Radium."

The meeting covered two days, the latter of which was devoted to clinical demonstrations at Huntington Memorial Hospital of the use of radium.

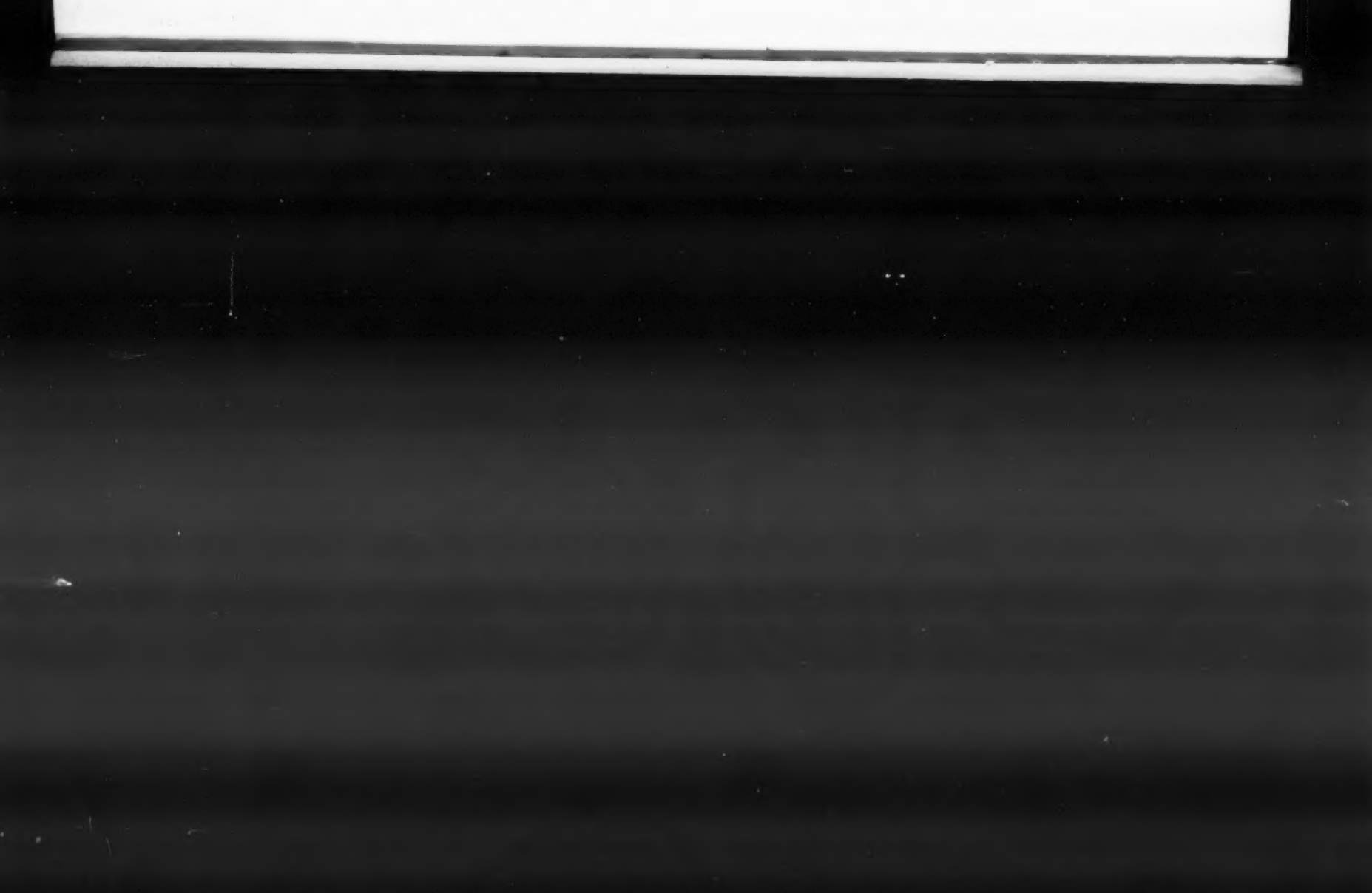
Dr. George E. Pfahler was elected president for the ensuing year.

A Licensing Board

THE science of Radiology has become an important factor in medical and surgical practice. Not infrequently, and with increasing occurrence, patients demand the scrutiny or treatment of their persons by men pursuing the Radiological Profession before submitting to the knife or accepting a pathological diagnosis as the basis for a course of action.

And what is the result? Simply that by its important place in the public mind, the Radiological Profession, like every other honorable profession at some stage of its progress, finds itself the father of what Theodore Roosevelt called a "lunatic fringe"—a bunch of incompetents, invincibly ignorant, but thoroughly conscienceless in their pursuit of "easy money."

It makes no difference so far as the public is concerned that the child is not their own offspring so long as it makes claim to their parentage and the Radiologists themselves do not publicly disown it. The fact is that by failing to proclaim its illegitimacy from the housetops, and to take steps forthwith to send it to a house of cor-



rection, the profession stultifies itself and provides the shield behind which these poachers on the profession can continue unrestrained their violations against common decency; provides the groundwork which they in turn pervert and use as a justification for preying on the public.

Recognition of these facts was responsible for the formation of The Radiological Society of North America and similar reputable organizations. As recognition of these same facts was responsible for the effort of the founders of The Radiological Society of North America to elevate their own standards by writing into its constitution the provision that only persons holding degrees from recognized reputable medical schools are eligible to membership.

But the mere exclusion of such persons from membership does not accomplish all that should be accomplished, all that must be accomplished if the Radiological Profession is to proceed unrestrained to its full fruition. The requirements of the Society as to its own members may serve to dignify the appellation "Radiologist" insofar as those are concerned who are rightly entitled to use it. It will, of course, indicate to such persons as know all the facts that members of The Radiological Society are competent and trustworthy diagnosticians.

But with the advent of deep therapy a new obligation is imposed on the members of the Society. They must not only keep the sanctity of their own household inviolate, but they must also guard the inalienable right of the public against assault by imposters. They must make it easy for the lay public to determine quickly and accurately the competence and reputability of every man who sets up a laboratory for x-ray diagnosis and treatment. They must provide the means by which the public can know when it submits its person to the skilled and painstaking diagnostician, schooled in searching for causes by the application of his knowledge of his own profession and of body structure and functions—and likewise provide the means by which that same public can know when it is being ravished professionally by a purely commercial x-ray photographer who "shoots" his patients without any sense of anatomy or knowledge concerning the incipiency and obliteration of disease.

To sum up: In view of their professional obligation, express and implied, Radiologists may not consistently or conscientiously say they have discharged their full duty when they have excluded the thief and rapist from their own particular organization. They must go further than that and make a sincere effort to protect the public which they serve from his operations.

All which calls for the ejaculation, "Yes, but how?"

To which there is but one answer —the creation of a permanent board for examination and licensure, with the hard and fast agreement on the part of every member of the Society that he will only employ licensed operators.

This done, and the fact made known to the public, together with the reasons supporting such a plan, a long step will have been taken toward the suppression of commercialized prostitution of the Radiological Profession by men neither worthy nor well qualified.

State Medicine

SO MUCH has been said by the press in a wholly superficial way about the immigration problem—a sort of "catch-as-catch-can" discussion of the most vital social question before the nation—that it seems almost necessary, as well as informative, to give very serious consideration to cer-

tain facts and figures, in which without doubt will be found those fundamentals on which the medical profession must build its future structure —from which, to be sure, spring those obligations and duties which the medical profession as an entity must fulfil and exactly perform.

To illustrate: If the members of the medical profession were asked simultaneously to give expression by the clock to their present and future socio-professional obligation, the result would unquestionably be a babel of tongues.

There is neither disrespect nor discourtesy in this statement. But there is in it full recognition of the fact that, under the present bucolic condition of affairs, the medical man, like most everybody else, finds himself betwixt and between, and is anxiously groping for a clear conception of the problem that will lead to a reasonable concert of opinion concerning what shall be the new order of things.

That is the reason for adherence to the declaration of purpose specified as public interest with which avowedly this discussion was begun.

And now, in order to get a correct and true perspective, it is necessary to get back behind the thing the public and the profession accept as the main issue, and try to discover causes in the long procession of events which give semblance of form and reality to the apparent demand for some form of state medicine.

No particular amount of mental brilliancy is necessary to discover that this equation is triangular in character. Given the base as that economic level incident to social subsistence, and the altitude, that social welfare which promotes physical and mental attainment, the medical profession is bound to determine the exact proportions of the hypotenuse of human progression so that it can serve effectually and intelligently.

And it is but a short step further in the process of logic, to the proposition that, the relative importance of ancestry, racial characteristics, and hereditary influences have a very incisive and precise effect on the efforts of the medical profession to accomplish a better public health by preventive methods.

Certainly no serious-minded person will question that this subject is one of utmost concern; and being of that opinion, the quest for specific data is both justified and creditable.

Following the principles laid down by Edward Grant Conklin, Professor of Biology at Princeton University, and in particular that one in which he said:

> "The best way of understanding adult structures is to trace them back in development to their simpler beginnings, and to study them in the process of becoming,"

the United States Census Figures under the heading "Foreign born population in 1910 distributed according to country of birth," when stated in detail, contain some highly interesting bases for certain conclusions, especially when taken in connection with the findings reported by The United States Surgeon General entitled, "Defects Found in Drafted Men," published in 1920. The 1910 Census shows a total "Foreign born population" of 13,515,886, distributed:

England	877,719
Ireland	1,352,251
Scotland	261,076
Wales	82,488
Norway	403,877
Sweden	655,207
Denmark	181,649
Netherlands	120,063
Belgium	49,000
Luxemburg	3,071
Germany	2,501,333
Switzerland	124,848
France	117,418
Portugal	59,360
Spain	22,108
Italy	1,343,125

Russia	1,602,782
Finland	129,680
Austria	1,174,973
Hungary	495,609
Roumania	65,923
Bulgaria	11,498
Serbia	4,639
Montenegro	6,374
Turkey in Europe	33,230
Greece	101,282
Europe not specified	2,858
French	385,083
Other	819,554
Newfoundland	5,080
Cuba	15,133
Other	32,502
Mexico	221,915
Central America	1,736
South America	8,228
Japan	67,774
China	56,756
India	4,664
Turkey in Asia	59,729
Asia not specified	2,591
Africa	3,992
Australia	9,035
Oceanic Islands—Pacific	2,415
Oceanic Islands—Atlantic	18,274
Total	13,515,886

And this is not all, for the Census in question, as is true of all Census figures, was compiled as of date April 1st, 1910. There must, therefore, be added the immigration statistics for the year 1910, given by the Immigration Department as 1,041,570, and distributed as follows:

Austria Hungary	258,737
Italy (including Sicily and Sardinia)	215,537
The Russian Empire and Finland	186,792
British North America	56,555
England	46,706
Germany	31,283
Ireland	29,855
Greece	25,888
Sweden	23,745
Turkey (including Serbia, Bulgaria and Montenegro)	23,142
Scotland	20,115
Mexico	18,691
Norway	17,538
Turkey in Asia	15,212
West Indies and Bermuda	11,244
Verda and Azore Islands	8,299
Netherlands	7,534
Denmark	6,984
Belgium	5,402
Switzerland	3,533
Spain (including Canary and Belearic Islands)	3,472
Japan	2,720
South America	2,151
Roumania	2,145
Wales	2,120
China	1,968
Other Asia	1,937
India	1,696
Central America	893
Europe not specified	151
Total	1,041,570
	13,515,886

Making a grand total of....14,557,456

Nor is this all. Congress has lately passed an emergency immigration bill limiting immigration into the United States during the next fourteen months to 3% of the foreign born population resident in the United States in 1910. Reduced to simple terms, that 3%, using the Census and immigration figures quoted as the basis of calculation, will permit the entry of approximately 450,000 immigrants in the United States during the next fourteen months. This means that the immigration for the period established will be forty-two and one-half per cent of the total immigration for the year 1910 and sixty-six and two-thirds per cent of the total immigration for the fiscal year ended June 30, 1920.

Using the scalpel of analysis for a little further separation, it is discovered that three per cent of the 1910 foreign population will permit the entry into this country during the next fourteen months of 75,000 Germans, 48,000 Russians, 40,000 Irish, 40,000 Italians, and 35,000 Austrians as the predominating races. In addition 210,000 more may be admitted distributed among a score of other races.

Nor is this all. The census figures include only those persons actually born in foreign countries. They take no account of offspring of foreign parents, even though those same parents may have been in the United

States but twenty-four hours at the time of delivery.

The figures quoted, a grand total of 14,557,456, must be multiplied three and a half times at least, to get a true picture of the medico-physico-economic problem at the present time. This is necessary because of high birth rate and additional immigration since 1910. Our national population is approximately fifty per cent foreign, a conclusion supported by the Surgeon General and visualized in a graph found in the forepart of the compilation already referred to.

That the facts disclosed by the Surgeon General were disturbing agencies in the minds of those men charged with the responsibility of a proper prevision for, and administration of the public welfare, is evidenced by the passage of this emergency immigration bill.

Whether Congress was not suffering from an acute case of "Three per cent sympathetic opthalmia" in disposing of so important a problem on this basis, may be somewhat of an open question, as will more fully appear hereafter in the critical processes of an exact analysis.

The point to all this is that there is a very intimate and important connection causally between our immigration problem and our public health problem. Of course, the medical profession realizes that fact. Of course, the medical profession knows that the public health problem is the larger, in fact, the inclusive problem. And knowing these things, no member of the medical profession will be heard to say that the scaling down or total abolition of immigration into the United States will in and of itself accomplish that state of public health to which the profession aspires.

But a clear conception of the relation between these two things, as well as a restatement of the motivating factors which lie underneath the health question, will furnish the groundwork for a long forward step. This on the assumption that the old rule which was learned at mother's knee—"An ounce of prevention is worth more than a pound of cure"—still holds good. That is the purpose of this and succeeding articles on this subject.

A Step Forward

IT is axiomatic, perhaps, that the one outstanding purpose of such organizations as The Radiological Society of North America is to promote the development of Radiology in order that it may be of greater scientific value to humanity. That, of course, means that the Society stands ready and willing at all times to encourage scientific research, to give by every honorable means stronger impulse to professional ideals, to procure for the labors of scientific men increased facilities for the conduct of their experiments, and to provide more universal recognition of, and usefulness for their accomplishments that their labors shall not have been in vain.

The progress of x-ray science during the past decade is one of the notable achievements. But there is now, as in every other occupation and profession, a very great need for a new impetus; an impetus which is not born of the vague enthusiasm of the dreamer, but which springs from the calculating mind of the expert as he applies his reasoning faculties and perceptive abilities to practical analysis and calm judgment.

Many such men have been steadily at work for a number of years in secluded laboratories. But the profession generally has had no means of knowing their aspirations or the direction which their labors assumed except through the unreliable channels of gossip, the vague and indefinite whisperings of "men on the inside," or the finished product which

embodied the secrets of their souls when it was offered for sale.

Doubtless, it will take a long time and a hard fight to break down the spirit of reserve which at the present moment infests not only the research laboratories of the manufacturers of equipment for purely commercial reasons, but also most, if not all, of the publicly supported institutions of research. Speaking frankly, however, we see no value in that sort of thing. It is a well known rule of law and evidence among the more adept patent counselors that the more a discoverer displays his find and discusses it with whomsoever he will, the better chance of proving his right thereto because of the number of witnesses at his disposal, provided, of course, he is not himself guilty of laches.

That is aside from the purpose of this article, though perhaps it may serve to indicate some of the reasons why our emotions are somewhat mixed as we approach the problem of bringing these scattered forces into more harmonious relation. Greater men than we have attempted the job and fallen in despair. But we are thoroughly resigned, hope beats strong in our breast, and duty beckons us proceed with measured tread to the end that our protestations of devotion to scientific progress may not "become as sounding brass, or a tinkling cymbal" in the eyes of the world.

Believing sincerely in the efficacy of complete coöperation between Radiologists and the manufacturers of x-ray equipment and apparatus, and such other aids and instruments as give reality to the diagnostic possibilities and healing powers of x-rays, The Journal has created a department which will be devoted exclusively to impartial discussion concerning new equipment, projected and completed. This discussion will be undertaken, in all cases, from the scientific side in its relation to the profession, and with cognizance of the hazards which lie in the path of those persons engaged in original research. While we shall always strive to be tolerant, yet we shall hold firm in our insistance that those instruments and appliances which do not measure up to the ideals of the profession be scrapped and a new effort made to attain that result. In every case, full credit will be given, where credit is due, to the particular man or men devising a method or instrument applying more beneficially those previously discovered properties or opening the door to the proper and scientific use of latent and now unemployed energies.

We believe, we hope we speak for all reputable manufacturers, physicists, and Radiologists when we say that it is their desire this department of The Journal be conducted without commercial restraint and absolutely free from the debilitating influences of petty jealousies and personalities.

Such a department, maintained on such a basis, should, and we believe will, be of incalculable benefit to everybody in any wise concerned with the development of the x-ray diagnostically or curatively. It will exert a profound corrective as well as protective influence, and stand as a monument to the scientific exploration of men zealous in the performance of duty and jealous of their reputation for honesty of purpose.

So mote it be.

New Equipment

FISCHER "DE LUXE" DENTAL UNIT

THE dentist and orthodontist particularly, as well as radiographers enjoying a reasonable amount of dental work, will find a great many points in favor of the Fischer "de Luxe" Dental Unit, manufactured by H. G. Fischer and Company, Inc., of Chicago.

There are dials and indicators at every point controlling the tube arm, and a fixed seat is provided, so that if the operator will make proper record on each patient's card, an exact duplication of angle and posture can be made at any future examination. This is often of the utmost importance. This unit is also equipped with cut-off switch, auto transformer control, volt meter, milliampere meter, automatic timer, and a switch throwing the current into the tube. The unit is compact, occupying 21x22 inches of floor space, and is mounted on large free rolling double castors.

CAMPBELL "CLINIX" X-RAY PLANT

FOR the Radiologist who is constantly looking for the most compact yet complete equipment, the Campbell "Clinix" X-ray Plant is worthy consideration.

With a motor driven tube tilt table, to the under side of which is attached the transformer, it combines all the appliances requisite for radiography and fluoroscopy, and eliminates all overhead wiring.

In gastro-intestinal therapy the diagnostician secures the position of the patient by tilting the table—the patient is relieved of all physical exertion and the mental strain incident to compliance with instructions.

WAPPLER FLUOROSCOPIC TRANSFORMER

THERE is a big advantage in the convenience and diverse operability of a small transformer and converter of sufficient capacity to meet fluoroscopic requirements. This appears to be the chief purpose of the Wappler Fluoroscopic Transformer and Control.

Such an apparatus is particularly valuable in diagnostic work, because it provides a separate power unit. It is also an ideal apparatus for the general practitioner who desires to do both radiography and fluoroscopy.

HUGUENOT TREATMENT TIMER

PROBABLY one of the most serviceable devices lately perfected for the benefit of Radiologists and Clinicians is the Huguenot Treatment Timer, manufactured by McKenzie Engineering Company of New Rochelle, New York.

This treatment timer cuts into the primary circuit, with a time dial, so that by moving the indicator to the treatment period desired the current is automatically cut out when the indicator reaches zero, or, stated otherwise, when the time period has run.

The outstanding advantages of this device, in treatment work, are accuracy, safety, and dependability, so that the Radiologist or Clinician may give other patients attention while the machine is in operation.

Such a device is invaluable and meets a professional need, as evidenced by the many makeshifts in use.

CAMERON'S SURGILITIES

OF particular interest to the surgeon is Cameron's set of Surgilites--consisting of five lamps of va-

rious sizes and shapes to meet every operating condition.

The Surgilites are distinct from Cameron's Diagnostoset, already in use by a great many diagnosticians.

Complete information concerning the Surgilites will appear in a later issue. It is sufficient recommendation, however, that they have been unqualifiedly endorsed by such men as Dr. Bevan, Dr. Billings and Dr. McArthur.

PATTERSON INTENSIFYING SCREEN

WITH the advent of the Potter Bucky Diaphgram the need for intensifying screens is greatly accentuated.

While the principle of intensification is not new, double screen technique is comparatively new.

Mottling and grain are the most frequent faults of intensifying screens. A good screen must be coated with a chemical combination of great permanence and stability so that the screen may last indefinitely and be unaffected by heat, light and dampness. A good screen should not require any seasoning.

The idea of "Double-screen technique" is to place the film or plate between two intensifying screens—the one fastened to the bottom of the cassette, the other to the lid or top. As the screen in the bottom of the cassette will be the one nearer the tube and between it and the negative, it necessarily must be of such a structure as not to interfere seriously with the action of the x-rays on the film or plate and on the other intensifying screen.

It was to meet these limitations that the Patterson "Special" was developed. This screen is made of the same fluorescent chemical as the Patterson "Standard." It has the same fine, smooth, glossy surface, and in addition, is thin and pliable.

In "Double Screen Technique" Patterson uses a combination of a "Standard" screen and "Special" screen. The one at the top is Patterson "Standard" and the one at the bottom is a Patterson "Special."

In cases where great penetration is required, as in radiography of the spine and head, double intensification is almost indispensable to satisfactory results.

Abstracts and Reviews

The purpose of this department is to furnish its readers a succinct epitome of current interesting articles and books. We will be glad to review articles which have been presented for publication or any manuscript or book sent us.

New Conceptions Relative to the Treatment of Malignant Disease, With Special Reference to Radium in Needles. William L. Clark, Philadelphia. Paper read before the General Meeting of the Medical Society of the State of Pennsylvania, Pittsburgh Session, October 5, 1920.

THERE is much yet to be learned in the treatment of malignant disease. But more can be accomplished now by combined methods than by surgery alone, as in the past. Operative surgery, electrothermic methods, radium and x-rays, alone or in combinations, are the most effective agencies.

Basal cell epitheliomata or rodent ulcers involving the face, especially about the nose, eyelids, etc., seldom metastasize. Total eradication by any method will cure. Squamous-celled and glandular types metastasize early and are hard to cure. The most difficult are the malignancies of the lips, buccal surface, tongue, floor of mouth, alveolus, antrum, tonsils, soft palate, pharynx, epiglottis, larynx, esophagus, stomach, breast, uterus, rectum, etc. Block dissection of glands involved and uninvolved is insufficient. The lethal action of radium, and in a lesser degree of the x-ray, upon malignant cells of all types has been proven in the laboratory and in practice. Undue exposure causes stimulation. Eighty to 100 mg. of radium will kill cancer cells in seven hours. To get a lethal dose at a sufficient depth, the gamma rays are essential. Immature cells are most susceptible. On healthy cells small doses cause stimulation, larger ones congestion and even fibrosis. If the dose is too large, sloughing occurs. With proper exposure there will be inflammatory reaction, which will subside slowly. If the dose has not been too great the blood supply will be cut off and a fibrous scar remain. Radiation effects depend on quantity of radium, filtration, distance, and length of exposure. Radium should be given in sufficient quantity before operation where possible. A week should elapse. At least three cross-fire treatments should follow operative procedure. The x-ray, less potent, may be used to supplement this treatment.

Most physicists and radiumologists believe there is but little choice between the action of radium element and the emanation. The emanations decay and must be freshly prepared to meet expectations.

The adaptation of hollow metallic needles, each containing radium salt, representing a known quantity of radium element, has revolutionized radium technique. The author uses needles containing 5 to 10 milligrams. These are used for insertion into malignancies, growths and glands, or into an organ in the peritoneal cavity after the abdomen has been opened, or otherwise.

Radium needles are particularly adapted to growths too large for outside treatment by capsule or plaque. As many needles as necessary may be inserted 20 to 25 mm. apart, to any depth. The needles do not need to be used alone. They may be used in any combination. When inserted, the entire radiation is used in the tissue surrounding it. Filtration by selected metals is essential.

One case of pyloric cancer was treated by operation and direct insertion of radium into the pylorus. It is now one year since treatment and the patient is alive and well. Another case treated in the same way improved for a time, but later died.

The needles vary in length from 20 to 30 mm. In thickness they are about 2mm. The needles are made of alloy of steel and nickel. They may be introduced by hemostat or special application. A braided silk thread is always attached to the needle so that it may be withdrawn easily from the issue and to obviate losing the needle. Local anesthesia by two per cent novocaine and adrenalin is ordinarily used. If many needles are to be inserted a general anesthetic may be used.

Clinical experience disproves the objection made by some that secondary radiation causes sloughs and irritation. The soft, moist tissue may absorb the irritating rays; anyway the needles may be left in for twenty-four hours without causing sloughing. Of course, tissues of low vitality may break down if the dose is not accurately gauged. No damage has ever been known to arteries to cause bleeding. In some cases the needles have been left in for forty-eight hours and no sloughing has occurred.

Radium needle treatment should be given in a hospital under the strictest sterile conditions. In carcinoma the needles are left about eighteen to twenty-four hours; in sarcoma, about twelve hours. The treatment is repeated, if necessary, in six weeks.

Radium in needles has been used for too brief a time to permit of final analysis. This is a preliminary report. The results have been encouraging. It has been used for two years. Some malignant growths seem more resistant than others. One must guard against over-exposure. If there is no response in three or four full radium treatments, the lesion cannot be favorably influenced by further treatments.

Physicians and attendants must use great care in the handling of radium. Never once must one grow careless. Radium applicators should be handled with forceps. If a lesion can be treated more effectively and satisfactorily by some other method, no temporization should be allowed. All methods should be used, the safest first. In many cases radium needles will be the best.

E. W. ROWE.

Four Deaths from Working at the Radium Institute. Journal A. M. A., p. 1360, May 14, 1921.

WITH the facts shrouded in mystery, there are reports of three deaths from working in the London Radium Institute. A sister and two laboratory workers died of aplastic anemia. This is a newly recognized danger to the workers with radium and roentgen ray. Another death from the same cause occurred when Dr. Ironside Bruce succumbed. At the Radium Institute every precaution is taken to safeguard the staff. No nurse or attendant works longer than three months with radium. This period is followed by rest or a change in duties. All workers have two free days per week in the open. Blood examinations of every person employed in the Institute are made at frequent intervals. On the slightest show of anemia work is suspended. Radium is always handled with special instruments, but even from touching the apparatus the skin peels off and the nails become impaired. Fourteen persons on the nursing staff are employed in the direct application of radium. They carry on without any complaints.

E. W. ROWE.

Studies in Roentgen Ray Effects. W. Nokahara and J. B. Murphy, New York City. Journal Experimental Medicine, p. 433, April 1, 1921.

THE resistance of mice to transplanted cancer can be definitely raised by proper roentgenization of the lymphoid tissues. Heat and the injection of homologous living tissue produce more stimulation. The resistance in mice treated by roentgen rays is raised, but probably not as much as by these two other methods.

E. W. ROWE.

Roentgen Ray Indications for Tooth Extraction, and a Diagnostic Chart. Byron C. Darling, New York City. Journal of Dental Research, Sept., 1919.

THERE is no better way to diagnose teeth conditions that may need extraction than by the roentgenograms. Tooth extraction is not done as often as it should be. No other method will cure dental abscesses or remove the focus of systemic disease. Preferably the roentgenologist should make the interpretation, because he has his own viewpoint and cannot be biased by the dental work done in the past or by that to be done in the future. Commercial laboratories offer no professional service. Even a dentist cannot do his own x-ray work. That requires all the time of a competent man. The roentgenologist has a special training of his own which fits him for his work. The roentgenologist assumes a share of the responsibility which is an advantage to the patient. The writer's graphic chart is offered, which is good if the one who uses it is neat and accurate in placing his notations upon the space provided.

E. W. ROWE.

The Scope of Radiotherapy in Disease of the Skeleton. Isaac Levin, Clinical Professor of Cancer Research, New York University and Bellevue Hospital Medical College X-Ray Bulletin, Hospital Division, U. S. Public Health Service.

REPAIR in tissue is accompanied as a rule, by changes in the normal tissue. Bone changes are different from those in other tissues. In bone there are special cells for regressive processes called osteoclasts, and for progressive changes they are called osteoblasts. Osteoporosis occurs just as in any tissue reaction to an injury from inflammation or a growing tumor. Osteosclerosis is the tissue reaction to the irritation, or Nature's method of healing, of overcoming the pathological process. Both processes may be present, and one of them so predominate that the other is difficult to see.

In skeleton metastases of carcinoma these two reactive processes are present. Usually the osteosclerosis is very imperfect and the spontaneous healing imperfect.

The writer has demonstrated that radium and roentgenotherapy may enlarge the healing power, destroy a part of the malignant tumor, and surround it with newly formed bone. Two cases are presented which illustrate this action of radium on tumors of the skeleton. One was a patient with a tumor of the breast and a pathological fracture through the humerus. This was treated with radium. In two weeks' time roentgenograms were made showing abundant callus. In the other case a malignant tumor was excised from the tibia. Radium treatment stimulated new bone formation and in one year the cavity was filled.

Dr. Levin thinks that radium stimulates a rapid formation of new bone and that callus occurs more quickly than in ordinary traumatic fracture. He thinks radium will hasten callus formation in fractures of all kinds and in bone grafts.

In the discussion of the relative value of radium and roentgen rays he thinks that radium is superior for this purpose, but that roentgenotherapy may in time, due to improvement in technique, approach it.

E. W. ROWE.

The Roentgenologist and the Hospital. Byron C. Darling, New York City. The Modern Hospital, December, 1920, Vol. xv. No. 6.

"FOR the hospital desiring competent roentgenology service — an indispensable aid in obtaining accurate diagnoses, there is but one course open: the development of a well-equipped x-ray department in charge of a physician who is thoroughly acquainted with the technical and photographic phase of this work, as well as the medical possibilities and limitations of the x-ray examination. To secure this type of service the hospital should allow sufficient funds to permit its development, and establish a scheme of remuneration based on a consideration of the different classes of patients—the roentgenologists receiving fees as do physicians and surgeons, and sitting with the medical board whenever it meets."

This is the author's own abstract of a thorough and frank discussion of the relations between the roentgenologist and the hospital. His discussion is summarized as follows:

1. The x-ray department is most important, since diagnosis is assisted, unnecessary operation avoided, the stay in the hospital shortened, the bed capacity raised, and the cost of maintenance lowered.

2. A competent medical man should be placed in charge, with sufficient funds to develop the department.

3. Salary or percentage basis is unsatisfactory. Both methods have questionable ethical and business values. He should receive fees from private and workmen's compensation patients, and do the charity work without charge.

4. To have technicians in charge of the x-ray department without medical supervision is contrary to sound practice and unfair to the medical roentgenologists.

5. The hospitals should uphold medical roentgenologists by insisting upon proper medical supervision.

6. Remuneration may be ideally arranged on the basis of classification of patients: private, workmen's compensation, and charity patients. The roentgenologist would receive fees from the private patient just as a visiting physician or surgeon does, adjusting the fees to the patient's means; he would give free service to the charity patients; he would charge workmen's compensation cases at a standard rate,

7. The roentgenologist should receive the title of visiting or associate physician, and be given a seat on the medical board.

E. W. ROWE.

X-Ray Treatment of Epithelioma with Thin Filters. John Remer and W. D. Witherbee, New York Medical Journal, December 11, 1920.

"FILTERED roentgen rays, from the viewpoint of dosage, require only twice the time for a given number of skin units at full distance as at half distance, whereas in unfiltered dosage four times the time would be required to produce the same effect."

Results in the treatment of basal cell epithelioma are most satisfactory. They seldom metastasize, but remain local. Neglected cases with the mucous membrane invaded, showing marked induration, do well with the unfiltered treatment. This applies more particularly to the ulcerative type. The lesion and one half to three-quarters of an inch of surrounding tissue should be subject to radiation.

The following technique is recommended: Filter of one-quarter of a millimeter of aluminum, six-inch gap, five milliamperes, ten-inch distance, and time varying from three to seven minutes. The filter may be up to three-quarters of a millimeter in thickness, just so the total dose of rays is from one and one-half to two and one-half skin units.

The advantages are:

1. Treatment can be repeated in two to three weeks' intervals without local reaction.
2. These treatments at short intervals are more favorable because they have a direct action on the malignant cells while undergoing mitosis. Moderate doses at frequent intervals to reach the young embryonic cells are the main objects to attain.
3. There is less danger from the size of the dose because the filtered ray is not too great in quantity.
4. This method is applicable for use on the smaller (2 k. w.) machine.

E. W. ROWE.

Arithmetical Computation of Roentgen Dosage. George M. MacKee, New York Journal of Cutaneous Diseases, Dec., 1919, vol. xxxvii., pp. 783-789.

THIS is an excellent summary of the principles involved in superficial therapy. For those wishing to master cutaneous therapy the exposition here given is essential. The so-called indirect or electrical method of estimating the roentgen dose antedates all other methods. The introduction of interrupterless transformers and the Coolidge tube have made this method more reliable and simple than the direct method, the use of pastiles and photographic paper.

The discussion of electrical measurement, biological standardization and radiometric standardization is followed by concrete examples to show how the formula may be applied. There is nothing new in the paper, but it is a complete resume and exposition of dosage as applied to cutaneous therapy. It will be a good reference for study and a guide to one wishing to be exact in the treatment of skin diseases.

E. W. ROWE.

Pathology of Rheumatoid Arthritis in Relation to X-Ray Findings. Assistant Surgeon S. Woldenburg (R), U. S. Public Health Service X-Ray Bulletin, May 15, 1921, p. 75. .....

THIS paper contains an excellent description of rheumatoid arthritis from the roentgen, clinical and pathological standpoint. The author presents a case which has been all worked out. But his thesis and his conclusions are in direct variance in an unusual manner. He says, "The x-ray as an aid to diagnosis in rheumatoid arthritis has proven of little value." In conclusion—"This case was one of the instructive types and yields sufficient evidence to show that the x-ray findings in this affection are of little positive value." The entire discussion shows that the pathological changes in rheumatoid arthritis are pronounced and definite. The roentgen findings are clear-cut and of great value in making a diagnosis. In fact, from his own description they appear almost pathonomonic. Why the writer does not claim more for the roentgen findings is not apparent in his paper.

E. W. ROWE.

BOOK REVEW

Injuries and Diseases of the Bones and Joints. Their Differential Diagnosis by Means of the Roentgen Ray. By Frederick H. Baetjer, Associate Professor of Roentgenology,

Johns Hopkins University; Roentgenologist to the Johns Hopkins Hospital; and Chas. A. Waters, Instructor in Roentgenology, Johns Hopkins University; Assistant Roentgenologist, Johns Hopkins Hospital.

THIS is a moderate sized volume, containing 332 radiographic reprints, carefully selected for the purpose of illustrating the various points in differential diagnosis.

The authors emphasize the importance of a thorough knowledge by the radiographer of the histology, anatomy and physiology of normal bones, all of which may have to be considered in arriving at a diagnosis in pathological conditions.

Attention is called to the fact that after all in the roentgenological study of bones and joints there are only two main points from which conclusions can be drawn, that is, bone destruction and bone production.

The following list of the subjects covered indicates the inclusive character of the book—normal bones, epiphyses, congenital dislocations, acquired dislocations, bone infections, joint lesions in children, joint lesions in adults, bone tumors, the spine, abnormalities, dystrophies.

The chapter on joint lesions in children and on bone tumors should be particularly commended, as they show a keen sense of the value of roentgenological interpretation and deductions.

The book is a treatise on diagnosis exclusively, and technique is not considered; neither does it offer a review of literature, its purpose being the presentation of a concise, complete, original contribution to the value of roentgenological study of bone and joint diseases.

The classification of bone tumors with the presentation of a method of elimination in arriving at a diagnosis shows a practical common sense method such as could only be developed by men of long experience in teaching.

This is one of the best American contributions to Roentgenology and meets a long felt want.

B. H. NICHOLS.

Roentgen Ray and Tuberculosis in Infants and Children. Frederick W. O'Brien, Forrest B. Ames. Journal A. M. A., May 28, 1921, p. 1474.

TUBERCULOSIS is recognized as a curable disease if its treatment is begun soon enough. The use of the roentgen ray is now a routine endorsed by all clinicians. Forty-four cases were studied in the Boston Consumptives' Hospital. History, clinical findings, sputum and roentgen studies formed the basis for analysis.

As a result it was found that the von Pirquet and intracutaneous skin reactions were reliable guides. In twenty-six out of thirty-six positive cases the roentgen ray disclosed the site of infection to be intrathoracic. D'Espine's sign was less reliable, occurring in only eleven cases out of the twenty-eight found positive by roentgen ray. In three cases was the sputum found positive. Fourteen cases of chronic pulmonary tuberculosis of the adult type were found. This number is greater than usually considered as occurring. In fifteen cases clinically negative, the roentgen ray sign showed marked structural changes suggesting strongly tubercular infection.

E. W. ROWE.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Journal of Radiology, published monthly at Omaha, Nebraska, for April, 1921.

STATE OF NEBRASKA } ss.
COUNTY OF DOUGLAS }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Herbert S. Tyler, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Journal of Radiology, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radiological Publishing Company, 511 City National Bank Building, Omaha. Editors, Dr. Bundy Allen, Iowa City, Iowa; Dr. B. H. Orndoff, Chicago, Illinois; Dr. A. F. Tyler, Omaha, Nebraska; Dr. E. W. Rowe, Lincoln, Nebraska. Managing Editor, Dr. A. F. Tyler, Omaha, Nebraska. Business Manager, H. S. Tyler, Omaha, Nebraska.

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is———— (This information is required from daily publications only.)

HERBERT S. TYLER,
Business Manager.

Sworn to and subscribed before me this 14th day of April, 1921.

(SEAL) HAROLD F. KEMP,
Notary Public.

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much for their own benefit and the benefit of the medical profession everywhere.

The Radiological Society of North America is glad that among its members are most of the members of The Canadian Society, for in that fact is found a tangible basis for belief in the ultimate achievement of those things to which all aspire.

American Radium Society

DR. HENRY SCHMITZ, retiring president of The American Radium Society, performed a highly significant thing, when, at the sixth annual meeting of that Society in Boston, he invited Dr. Alden Williams, president of The Radiological Society of North America, to speak.

Every Radiologist, of course, knows that radium has a very proper place in Radiology, just as the x-ray has a proper place in Radiology.

But in the hurrying and scurrying of every day life, when demands on one's time and energies are so multitudinous that occasionally one would fain fly away and forget it all, it is easy to become partial to the one or the other; and in the ardent advocacy of the one to the exclusion of the other, obstruct the attainment of the most satisfactory results.

That is why Dr. Schmitz's act was really a significant event; it gave public recognition to the inter-relationship, one might almost say interdependency, of radium and x-ray in the intelligent treatment and obliteration of disease.

It is a recognized fact that all medical organizations should coöperate in every conceivable manner for the betterment of all by the exchange of ideas and newly discovered facts. But this coöperation too often takes the form of mere lip service; and in view of the greater necessity for intimate association and effort by organizations and societies striving to accomplish identical purposes and moved by identical ideals, it is sincerely to be hoped that the incident which is the subject of this article is but the forerunner of mutual helpfulness like which the profession has never known.

Much beneficial discussion was indulged concerning the physics underlying the action of radium on the tissues, and Wm. Duane, Ph. D. of Harvard delivered a very commendable thesis making "A Comparison of X-rays with Gamma Rays of Radium."

The meeting covered two days, the latter of which was devoted to clinical demonstrations at Huntington Memorial Hospital of the use of radium.

Dr. George E. Pfahler was elected president for the ensuing year.

A Licensing Board

THE science of Radiology has become an important factor in medical and surgical practice. Not infrequently, and with increasing occurrence, patients demand the scrutiny or treatment of their persons by men pursuing the Radiological Profession before submitting to the knife or accepting a pathological diagnosis as the basis for a course of action.

And what is the result? Simply that by its important place in the public mind, the Radiological Profession, like every other honorable profession at some stage of its progress, finds itself the father of what Theodore Roosevelt called á "lunatic fringe"—a bunch of incompetents, invincibly ignorant, but thoroughly conscienceless in their pursuit of "easy money."

It makes no difference so far as the public is concerned that the child is not their own offspring so long as it makes claim to their parentage and the Radiologists themselves do not publicly disown it. The fact is that by failing to proclaim its illegitimacy from the housetops, and to take steps forthwith to send it to a house of cor-